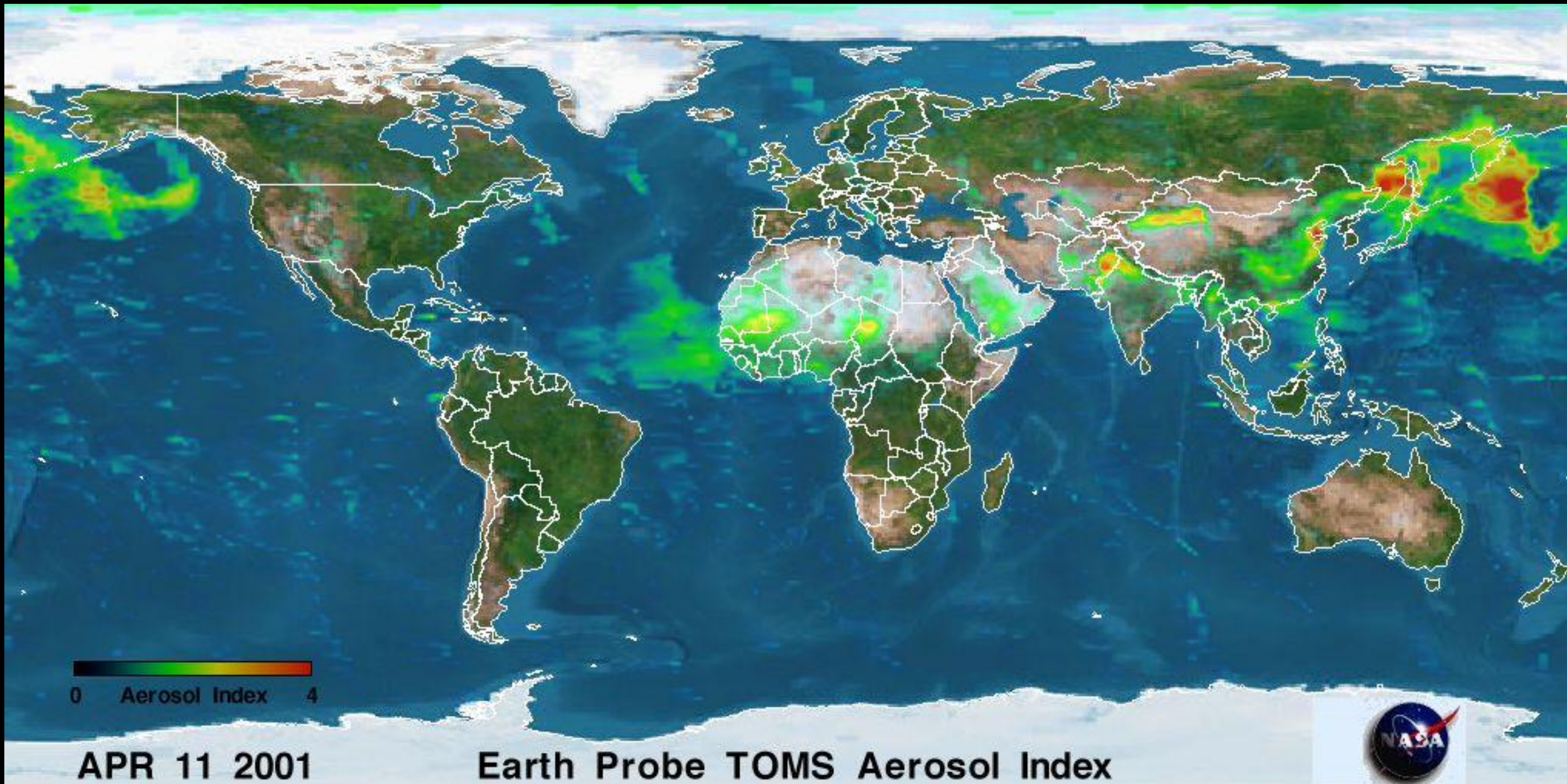
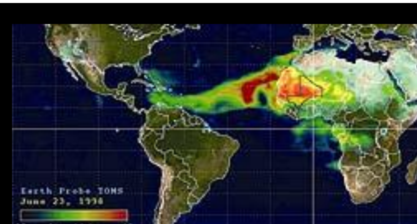
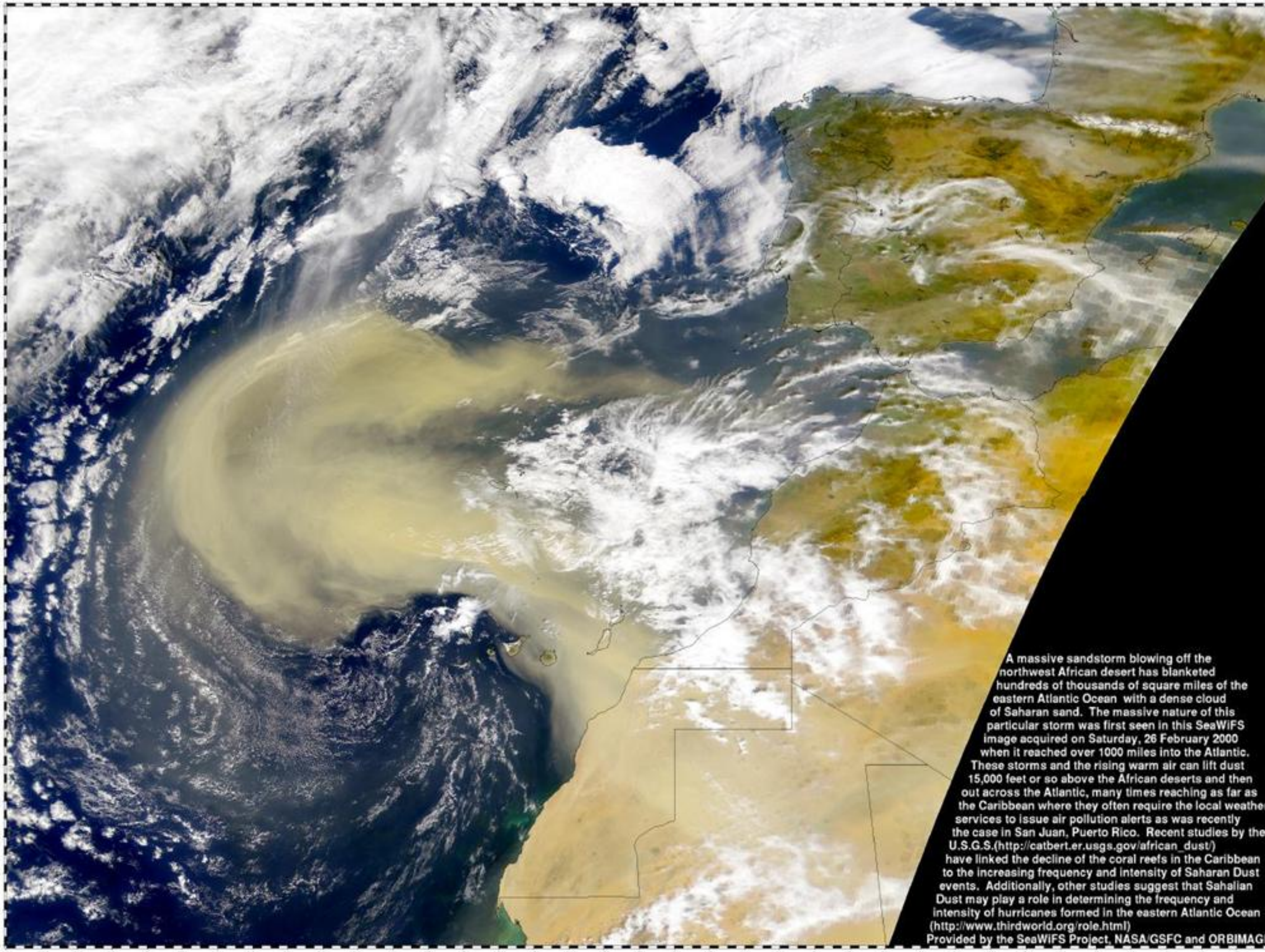
Climate change and climate systems influence and control the atmospheric dispersion of desert dust: Implications for human health



Dale W. Griffin, MSPH, Ph.D.
U.S. Geological Survey, Tallahassee, Florida




A massive sandstorm blowing off the northwest African desert has blanketed hundreds of thousands of square miles of the eastern Atlantic Ocean with a dense cloud of Saharan sand. The massive nature of this particular storm was first seen in this SeaWiFS image acquired on Saturday, 26 February 2000 when it reached over 1000 miles into the Atlantic. These storms and the rising warm air can lift dust 15,000 feet or so above the African deserts and then out across the Atlantic, many times reaching as far as the Caribbean where they often require the local weather services to issue air pollution alerts as was recently the case in San Juan, Puerto Rico. Recent studies by the U.S.G.S.(http://catbert.er.usgs.gov/african_dust/) have linked the decline of the coral reefs in the Caribbean to the increasing frequency and intensity of Saharan Dust events. Additionally, other studies suggest that Sahalian Dust may play a role in determining the frequency and intensity of hurricanes formed in the eastern Atlantic Ocean (http://www.thirdworld.org/role.html)
Provided by the SeaWiFS Project, NASA/GSFC and ORBIMAGE

African dust over St. Petersburg, Florida, July 25-28, 2005

Atmospheric particle concentration

July 15, 2005 (clear/normal conditions) = 3,000/Liter

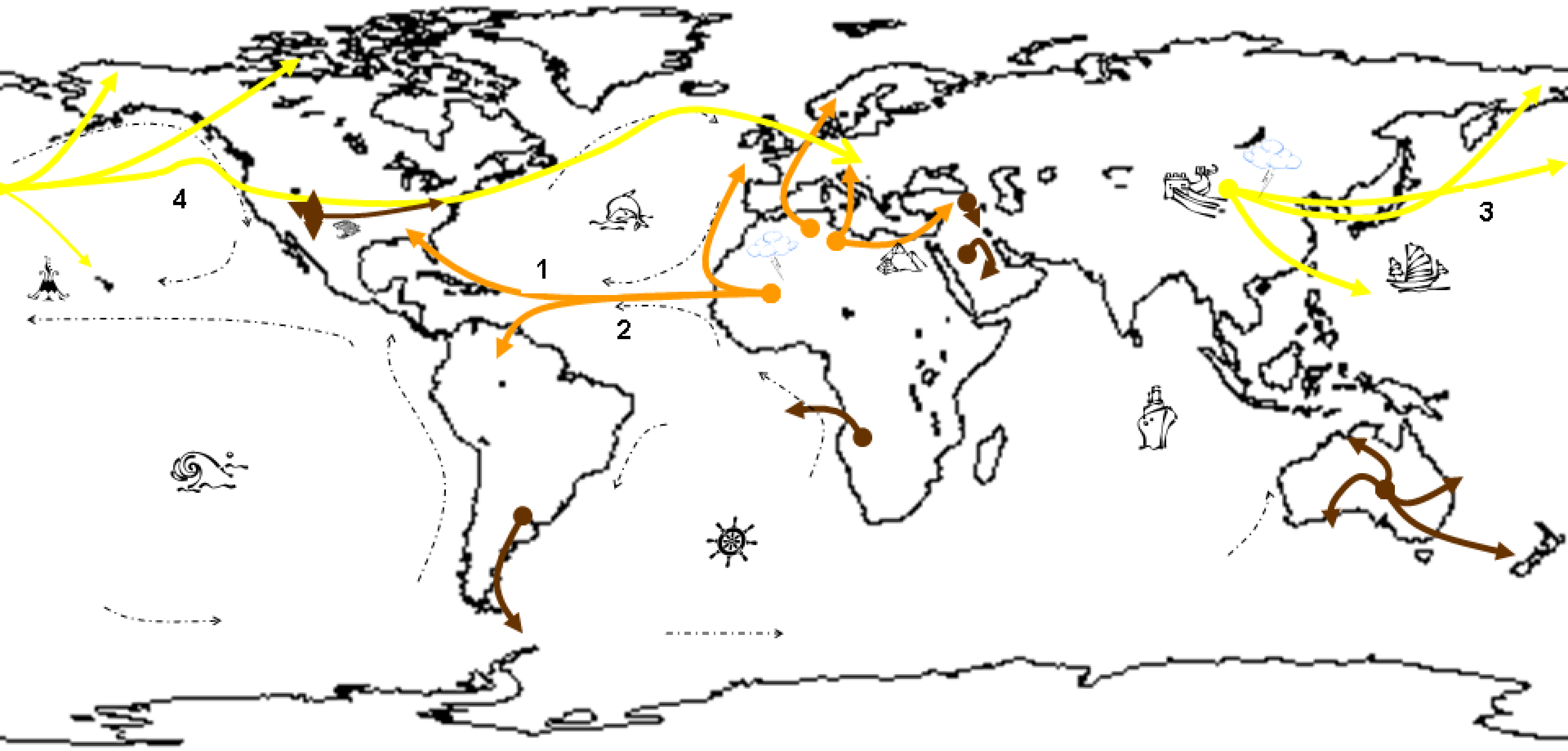
July 25, 2005 (dust conditions) = 30,000/Liter

7/15/05 avg. # particles	>0.3 - 0.5um	>0.5 - 0.7um	>0.7 - 1.0um	>1.0 - 3.0um	>3.0 - 5.0um	>5.0um
per cubic meter	2,641,437	83,684	35,281	39,410	36,284	1,158
%	93	2.9	1.2	1.4	1.3	<0.1

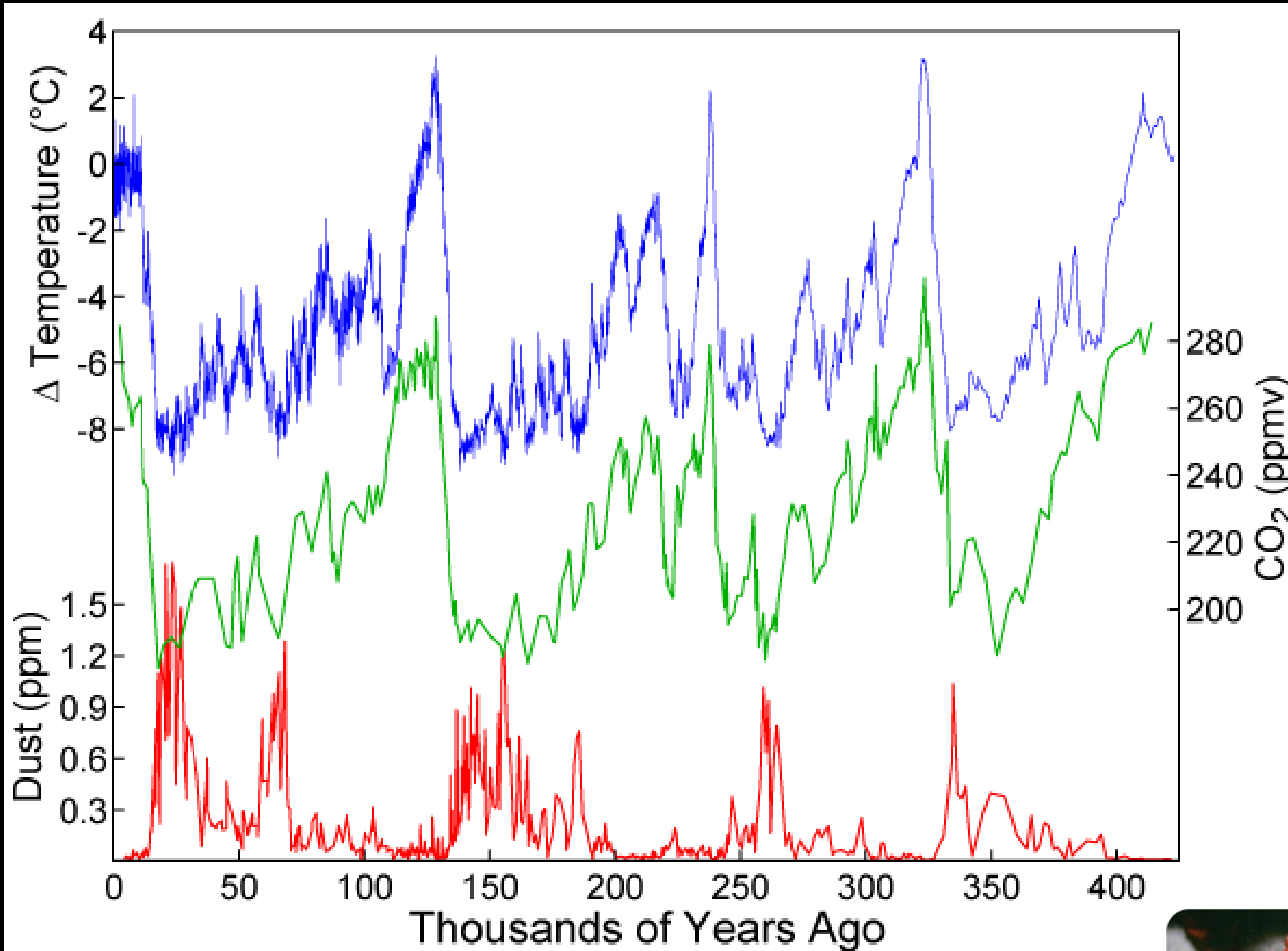
7/25/05 avg. # particles	>0.3 - 0.5um	>0.5 - 0.7um	>0.7 - 1.0um	>1.0 - 3.0um	>3.0 - 5.0um	>5.0um
per cubic meter	26,133,056	2,041,274	576,499	209,218	71,745	3,335
%	90.8	7.1	2	0.7	0.2	<0.1

Dust/no visible-dust	9.9	24.4	16.3	5.3	2.0	2.9

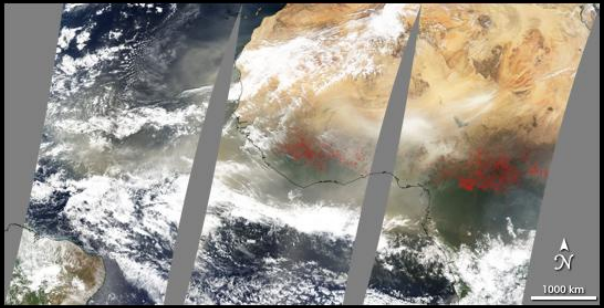
Typical dust cloud sources and routes

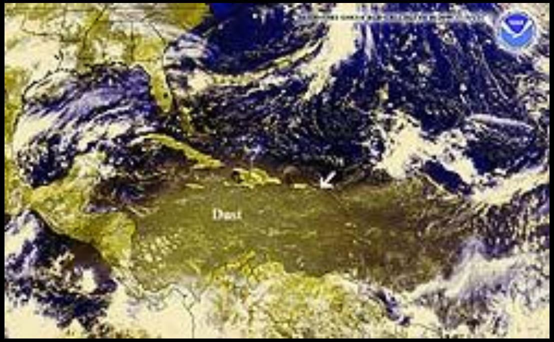


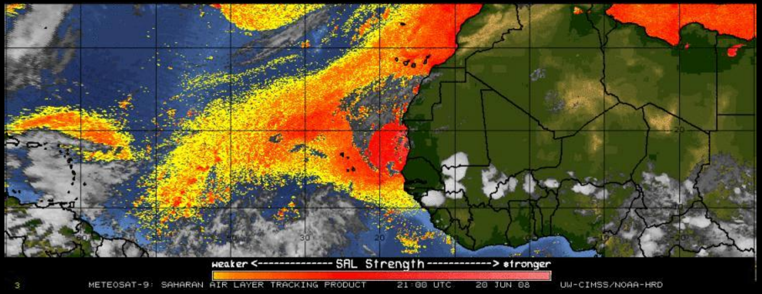
~ 3 billion metric tons of dust moves through Earth's atmosphere each year

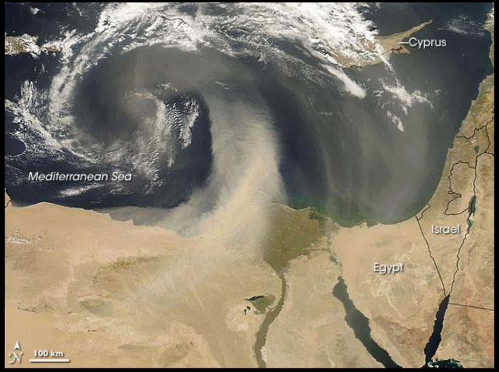


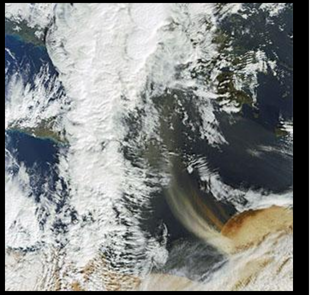
Vostok ice core











African dust

1940’s – 1960’s = ~126 x 10^6 tons/year
1970’s = ~317 x 10^6 tons/year
Since 1980’s = ~1,275 x 10^6 tons/year
1984 hard drought = ~3,760 x 10^6 tons

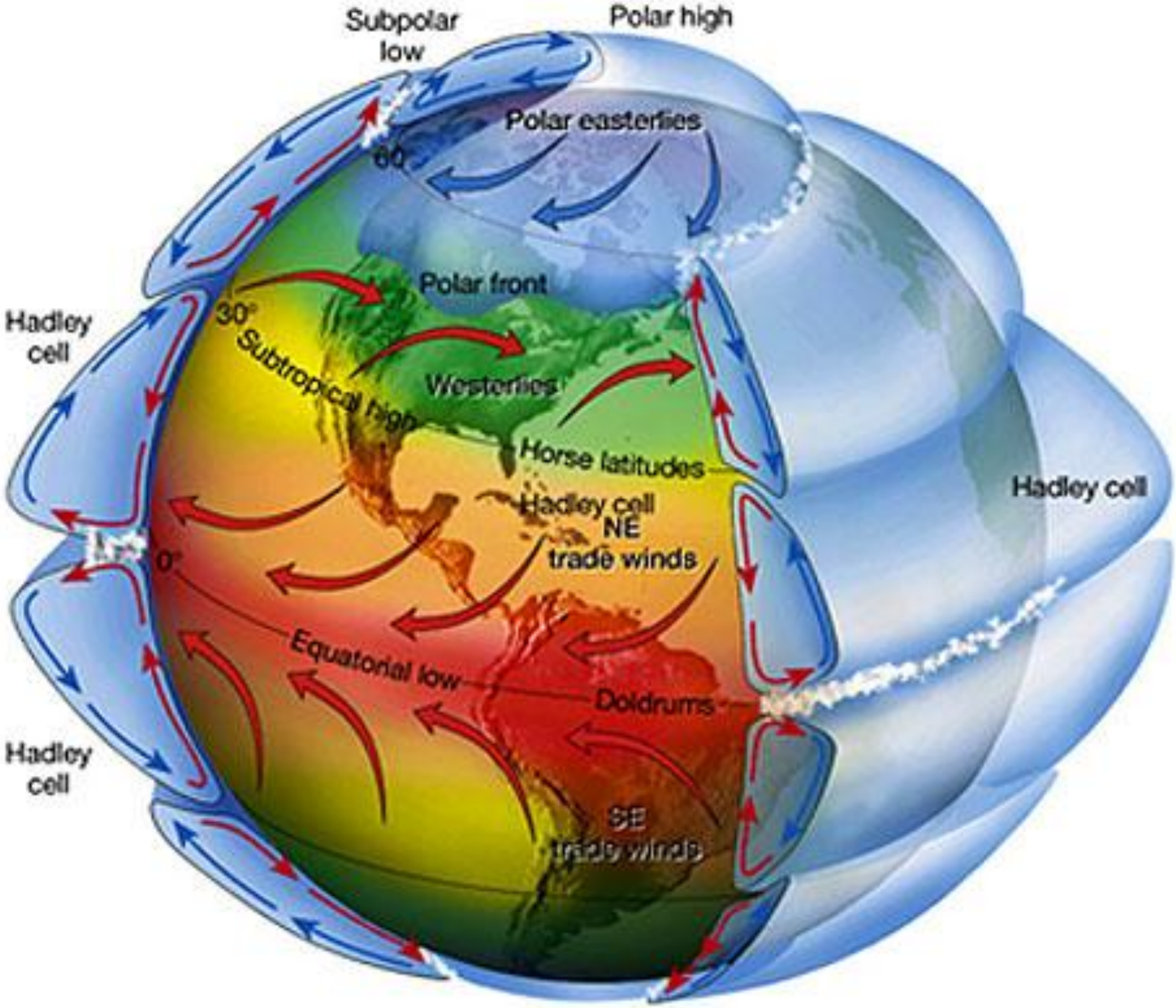
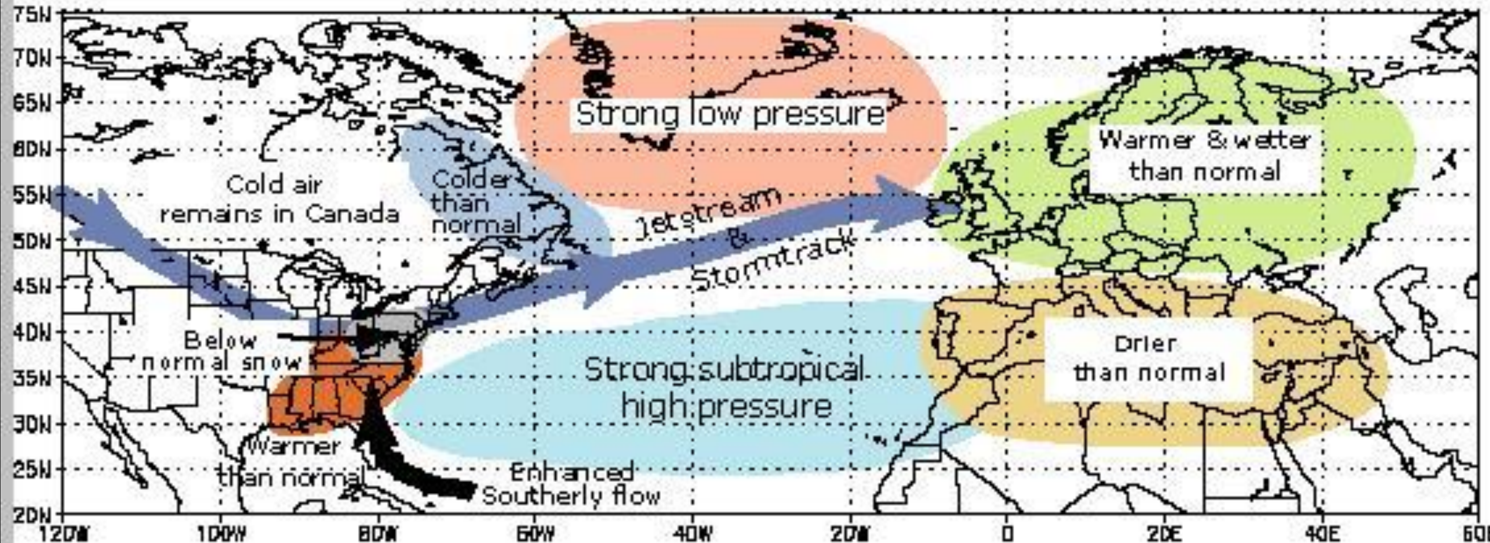


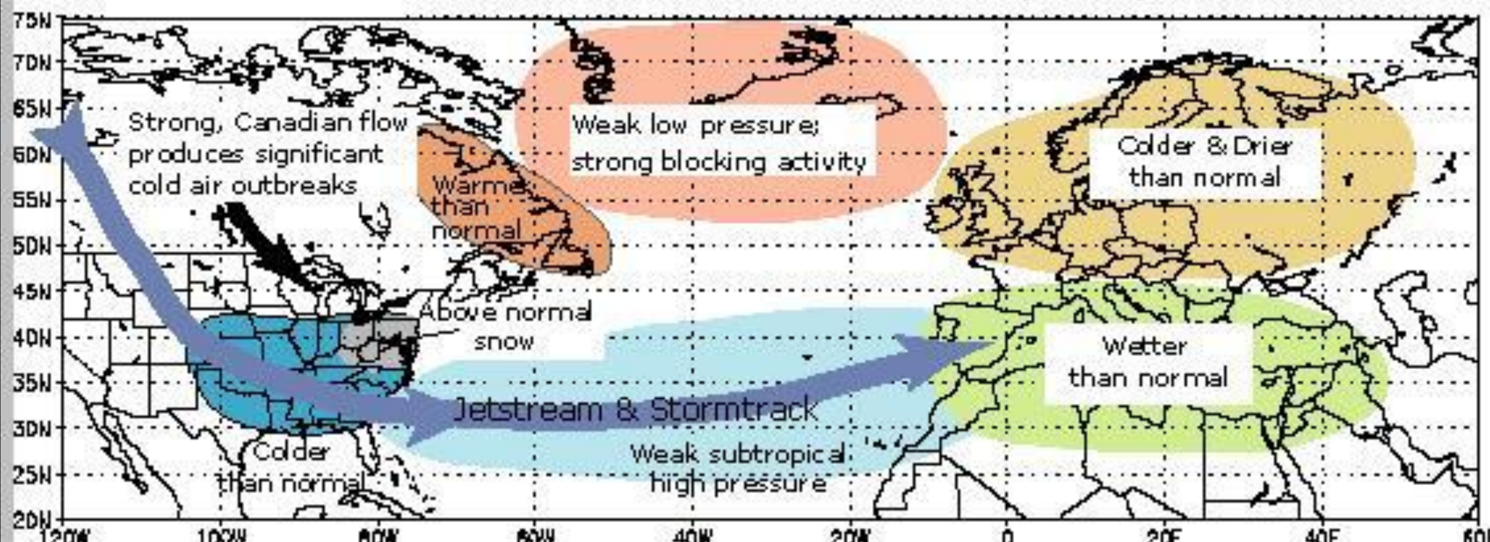
Image courtesty - http://apollo.lsc.vsc.edu/classes/met130/notes/chapter10/graphics/threecell_3d.jpg

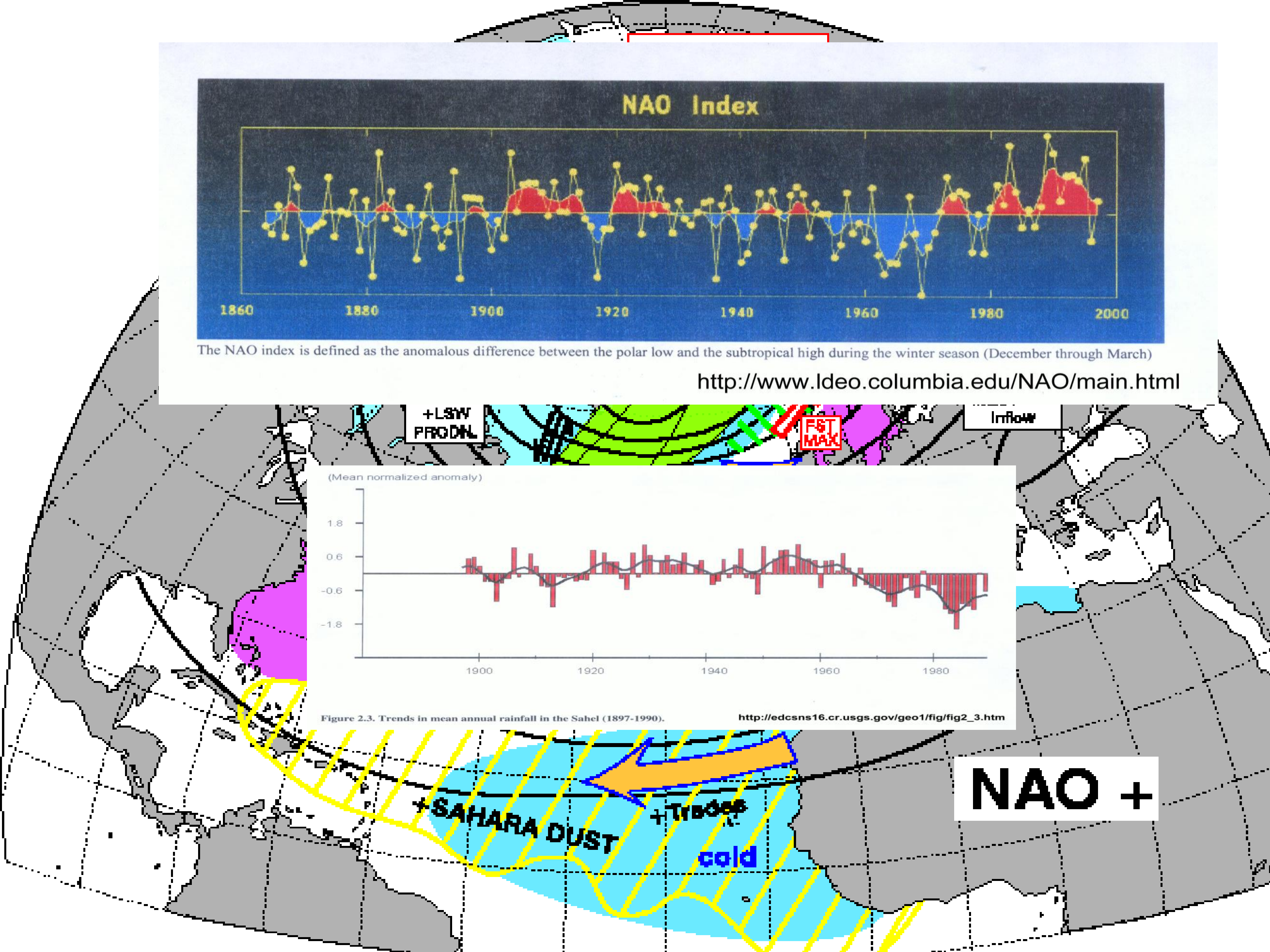

March-May
Aral Sea
June-October
November-May
dust activity
dust movement
storm activity
wind pattern

Positive Phase of the Wintertime North Atlantic Oscillation (NAO)



Negative Phase of the Wintertime North Atlantic Oscillation (NAO)





NAO Index
1860
1880
1900
1920
1940
1960
1980
2000
The NAO index is defined as the anomalous difference between the polar low and the subtropical high during the winter season (December through March)
http://www.ldeo.columbia.edu/NAO/main.html
+LSW PRODN.
FST MAX
Inflow
(Mean normalized anomaly)
1.8
0.6
-0.6
-1.8
1900
1920
1940
1960
1980
Figure 2.3. Trends in mean annual rainfall in the Sahel (1897-1990).
http://edcsns16.cr.usgs.gov/geo1/fig/fig2_3.htm
+SAHARA DUST
+Trades
cold
NAO +

176 A.S. Goudie and N.J. Middleton

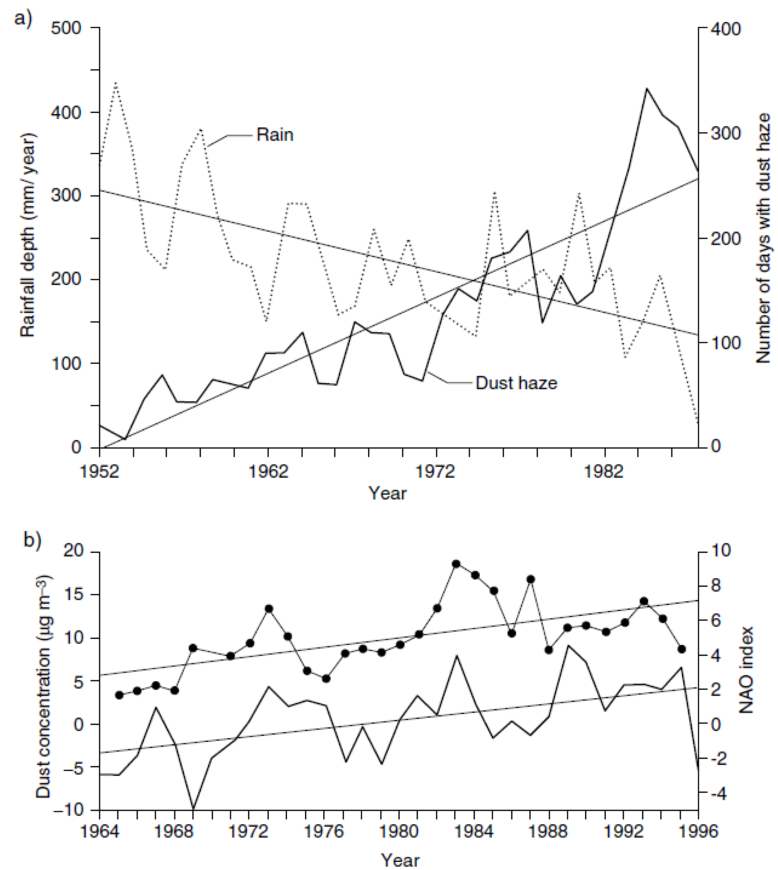
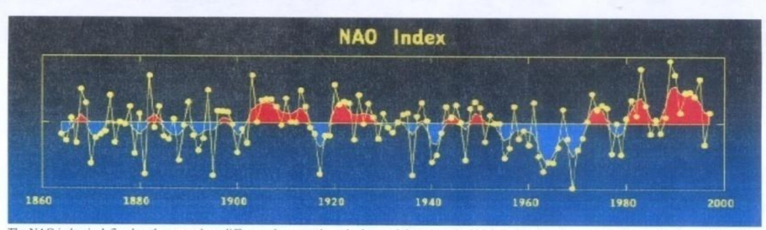


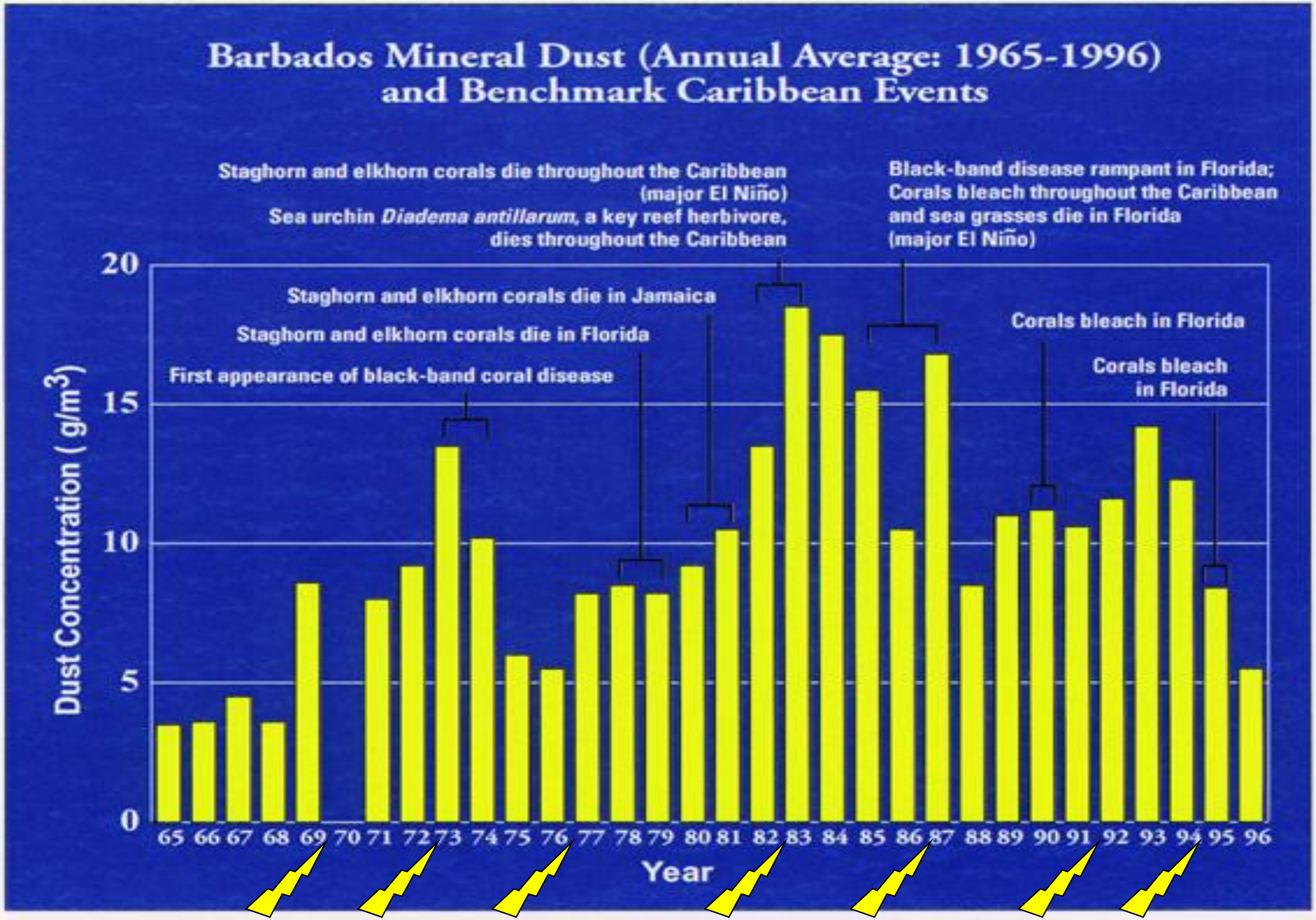
Fig. 7.7. a) The relationship between annual dust haze days and annual rainfall for the Sahelian station of Gao (16° N), between 1952 and 1987. Modified after N'Tchayi et al. (1994, Fig. 6). b) Comparison of the North Atlantic Oscillation (*NAO*) index (*bold continuous line*) with desert dust concentrations at Barbados in the West Indies, between 1964 and 1996. Modified after Moulin et al. (1997, Fig. 4)



The NAO index is defined as the anomalous difference between the polar low and the subtropical high during the winter season (December through March)

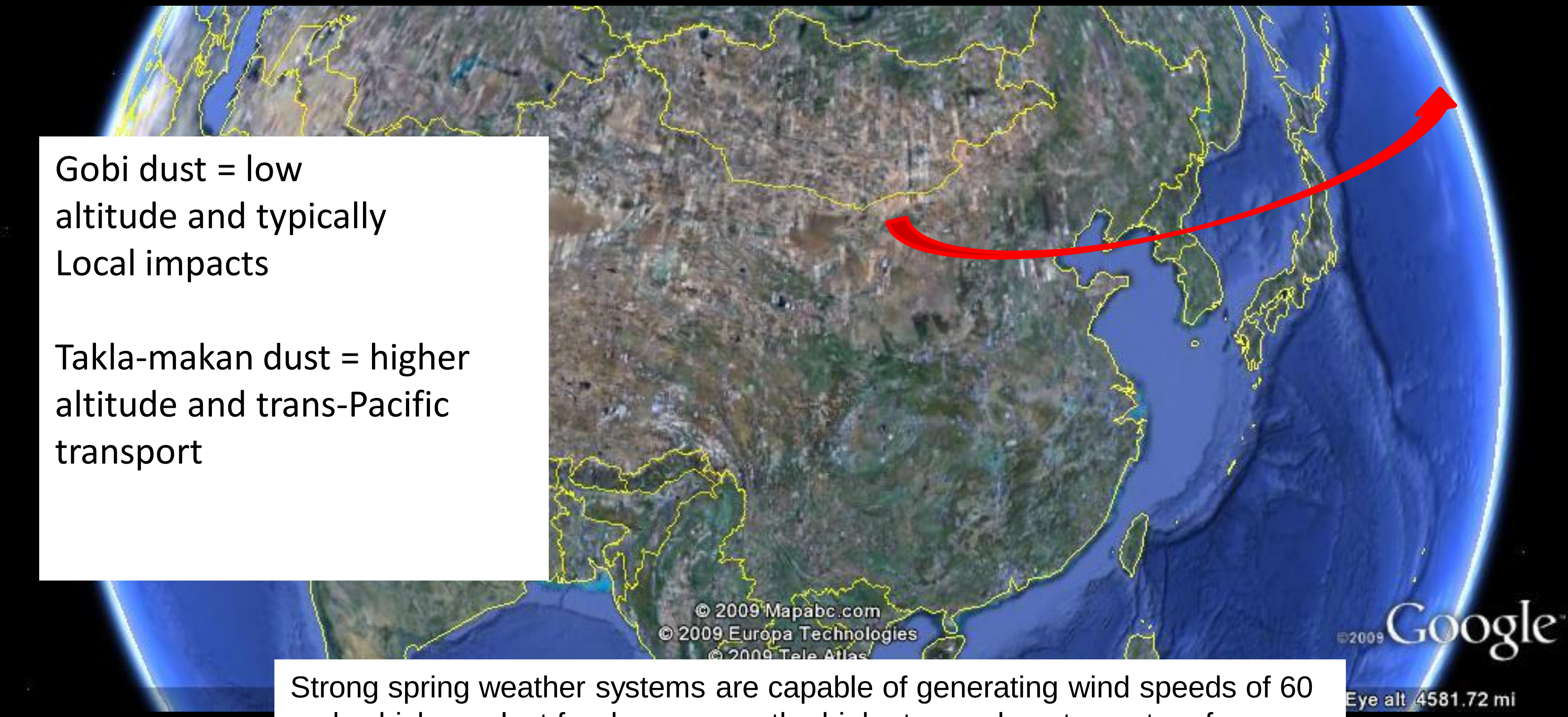
http://www.ldeo.columbia.edu/NAO/main.html

10°31'20.69" N 43°30'22.37" W elev -13503 ft



This graph, courtesy of Dr. Joe Prospero, University of Miami, shows the overall increase in African dust reaching the island of Barbados since 1965. Barbados is situated in the Windward Islands, which are hidden beneath the cloud of dust shown in the satellite image on the second page. Notice that peak years for dust deposition were 1983 and 1987. These were also the years of extensive environmental change on Caribbean coral reefs.

Gobi and Takla-makan Deserts
Peak season from Mid-February to late May
Maximum transport occurring between mid April and May

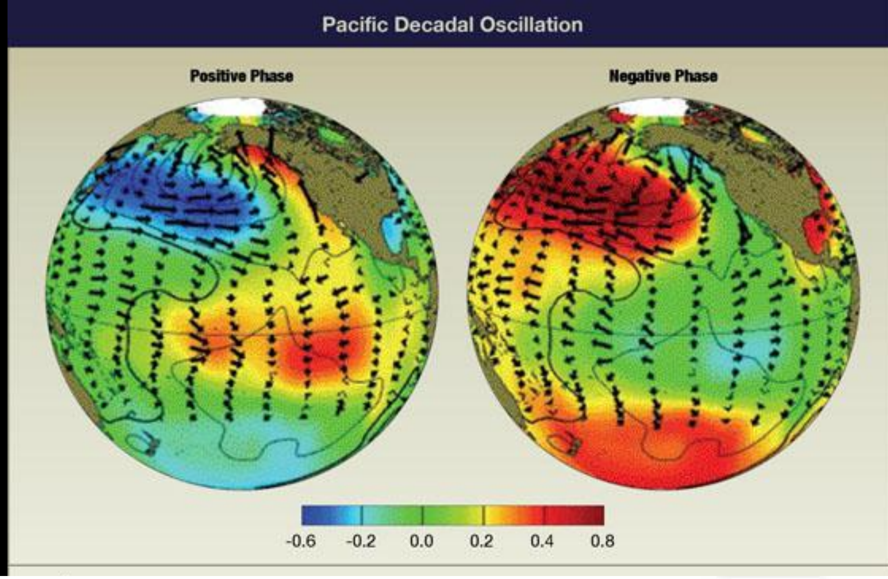


Gobi dust = low altitude and typically Local impacts

Takla-makan dust = higher altitude and trans-Pacific transport

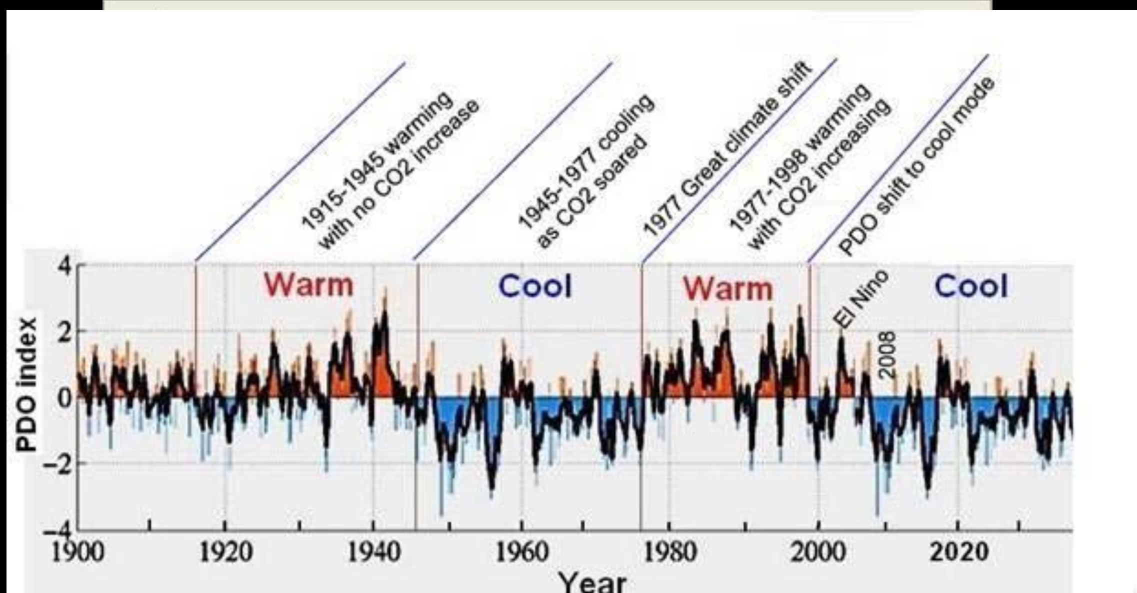
Strong spring weather systems are capable of generating wind speeds of 60 mph which can last for days across the high steppe desert country of Mongolia and western China. Part of the reason these dust storms are so severe, is that the soil is so loose and fine. To quote Sven Hedin's account Of the Takla-makan desert in 1895,

"...crossing a dead-flat plain of yellow-grey dust—nothing but dust, so fine that it blew like powder at every breath of the wind,"



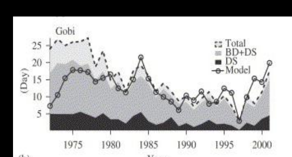
PDO events persist for 20 – 30 years. Climatic impacts in the North

ENSO events last 6 to 18 months. Climatic impacts in the Tropics



La Nina years = Increase in dust Loading and trans-Pacific transport

US Dust Bowl



Hara et al. 2006. Atm. Env, 40(35):6730-6740

1998 Asian dust event that impacted N. America reduced solar radiation levels by 30 – 40% and left a chemical fingerprint inland to the sate of Minnesota

Glen Canyon, SW Continental USA

April 16th, 2001

Huge Dust Cloud Circled World in 13 Days

Wednesday, July 22, 2009
FOX NEWS

Print | ShareThis

NASA

A huge dust storm moving eastward across the Sea of Japan on March 17, 2002.

A gigantic cloud of dust that originated in China's western deserts made its way around the world in 13 days, a new study reports.

Japanese researchers, writing in the scientific journal Nature Geoscience, used NASA satellite data to track the massive cloud, which formed in early May of 2007.

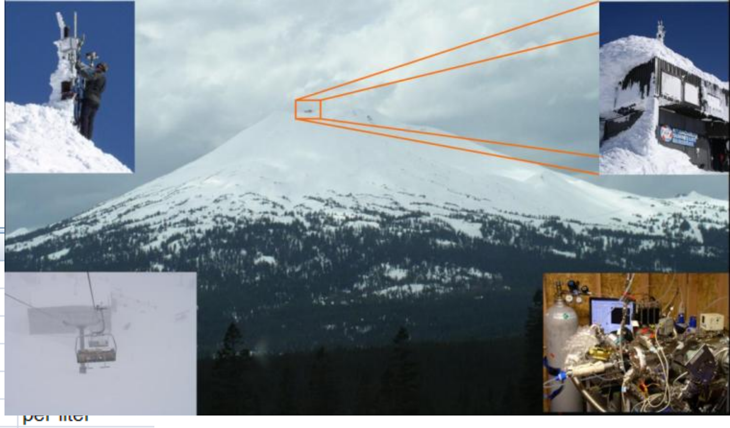
The cloud was so durable that it passed over the Pacific Ocean twice, finally coming apart and dropping down to the surface the second time.

"The most important achievement is that we tracked this through one full

In 2003, a group at Atmospheric and Environmental Research, Inc., in San Ramon, CA, computed that between 5% and 36% of all airborne mercury in the US comes from Asia.

In 2001, satellites tracked a monster cloud of Gobi dust, which produced hazy skies across China and dumped 52,500 tons of particulate matter—the equivalent weight of 290 Boeing 747s—throughout the US.

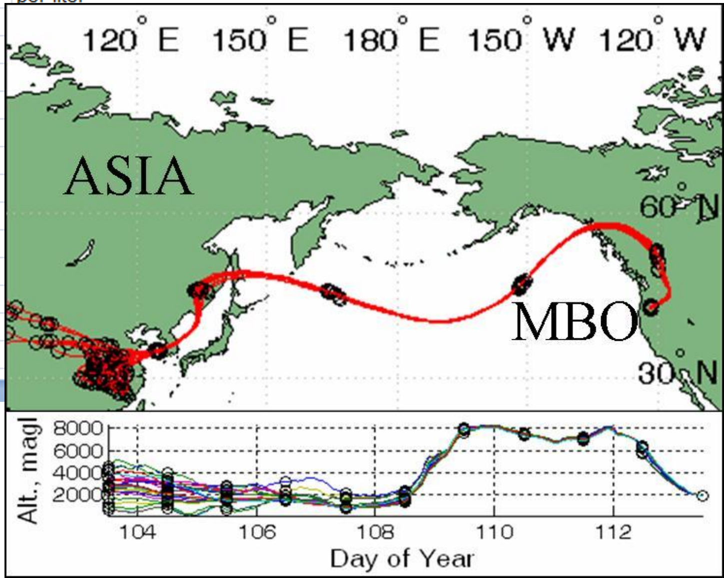
Mount Bachelor Observatory, Bend, Oregon, April 29, 2009



	A	B	C	D	E	F	G	H	
1	Timestamp	>0.3	>0.5	>0.7	>1.0	>2.0	>5.0	Model	
2	4/29/09 9:10:54	8785	523	141	71	28	0	Pro	
3	4/29/09 9:20:54	8573	508	127	71	14	0	Pro	
4	4/29/09 9:30:55	8644	480	127	71	14	0	Pro	
5	4/29/09 9:40:55	10085	664	184	99	28	0	Pro	
6	4/29/09 9:50:56	9802	579	155	85	28	0	Pro	
7	4/29/09 10:00:56	9859	565	155	85	14	0	Pro	per liter
8	4/29/09 10:10:57	10085	636	184	99	28	0	Pro	per liter
9	4/29/09 10:20:57	10028	678	198	99	28	0	Pro	per liter
10	4/29/09 10:30:58	9619	650	184	99	28	0	Pro	per liter
11	4/29/09 10:40:58	8870	565	141	85	28	0	Pro	per liter
12	4/29/09 10:50:59	8983	565	155	85	28	0	Pro	per liter
13	4/29/09 11:00:59	9251	607	169	99	28	0	Pro	per liter
14	4/29/09 11:11:00	9421	636	184	99	28	0	Pro	per liter
15	4/29/09 11:21:00	9308	621	169	99	28	0	Pro	per liter
16	4/29/09 11:31:01	8658	523	141	71	14	0	Pro	per liter
17	4/29/09 11:41:01	17006	847	169	85	14	0	Pro	per liter
18	4/29/09 11:51:02	12373	706	155	71	14	0	Pro	per liter
19	4/29/09 12:01:02	7472	508	141	71	14	0	Pro	per liter
20	4/29/09 12:11:03	7641	508	141	71	14	0	Pro	per liter
21	4/29/09 12:21:03	7585	508	141	71	14	0	Pro	per liter
22	4/29/09 12:31:04	37627	1794	339	141	28	0	Pro	per liter
23	4/29/09 12:41:04	19802	1045	240	113	28	0	Pro	
24	4/29/09 12:51:04	9859	650	155	71	14	0	Pro	
25	4/29/09 13:01:05	48178	2684	508	198	28	0	Pro	
26	4/29/09 13:11:05	60791	3164	607	240	42	0	Pro	
27	4/29/09 13:21:06	14407	833	184	85	14	0	Pro	
28	4/29/09 13:31:06	8178	551	141	71	14	0	Pro	
29	4/29/09 13:41:07	5706	367	99	56	14	0	Pro	
30	4/29/09 13:51:07	4068	268	71	42	14	0	Pro	
31	4/29/09 14:01:08	5551	466	127	71	14	0	Pro	
32	4/29/09 14:11:08	7189	579	169	85	14	0	Pro	
33	4/29/09 14:21:09	7641	621	169	99	14	0	Pro	
34	4/29/09 14:31:09	7811	593	155	85	14	0	Pro	
35	4/29/09 14:41:10	5367	339	99	56	14	0	Pro	

Data / Graph all / Graph 0.3 / Graph 0.5 / Graph 0.7 / Graph 1.0 / Graph 2.0 / Graph 5.0 / Alarm

Images and Figure from MBO website
www.atmos.washington.edu/~thornton/MBO.html
courtesy Dan Jaffe, UW, Bothell



Particle size in um

Re: Asian dust microbiology
Dale W Griffin to: Daniel Jaffe

Sample period	Bacterial CFU versus Avg. Particle counts per cubic meter of air. Pearson Correlation (P)	Fungal CFU versus Avg. Particle counts per cubic meter of air. Pearson Correlation (P)	Total Bacterial and Fungal CFU versus Avg. Particle counts per cubic meter of air. Pearson Correlation (P)
Long	.241(.429)	.392(.185)	.463 (.111)
Short	.464(.03) sig. at .05	.693(.000) sig. at .01	.811(.000) sig. at .01
Combined	.366(.031) sig. at .05	.616(.000) sig. at .01	.709(.000) sig. at .01

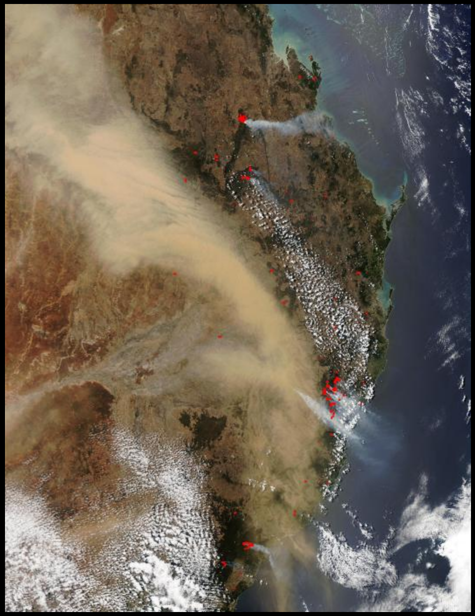
Australia – high dust in El Nino years

Sept – Dec = peak dust season

Lake Eyre is the prime source region – a natural dry lakebed that floods Approximately every 10 years (monsoons)

Most dust transport is E and SE (large events impacting New Zealand air quality) with occasional N transport

Subtropical Indian Ocean High – movement to the west = cool dry winds into the Australian interior that results in increased dust storm activity



El Nino conditions = no rain….no runoff……….dust event moved through area on 23 October 2002

CRIMSON TIDE - Algae a taste of this summer's blooming drought

The Daily Telegraph , 05-11-2002 , Ed: 1 - State , Pg: 003 , 550 words , LOCAL
THE NSW coast is turning bright red, in what experts claim is an unprecedented rise in algal blooms. As a consequence, an eerie fluorescent green glow is beginning to appear at night in waters around Sydney Harbour. Yesterday the crimson tide had eng...

Terra – MODIS, Image 22385, http://visibleearth.nasa.gov

Photo courtesy of Dr. Tony Ladson, Civil Engineering, Monash University, Clayton, Victoria, Australia

THE INFLUENCE OF DUST ON CLIMATE

Drying in the Western North Atlantic = increased African dust transport that Suppresses tropical cyclone (hurricane) formation via increased vertical wind shear and limiting deep convection

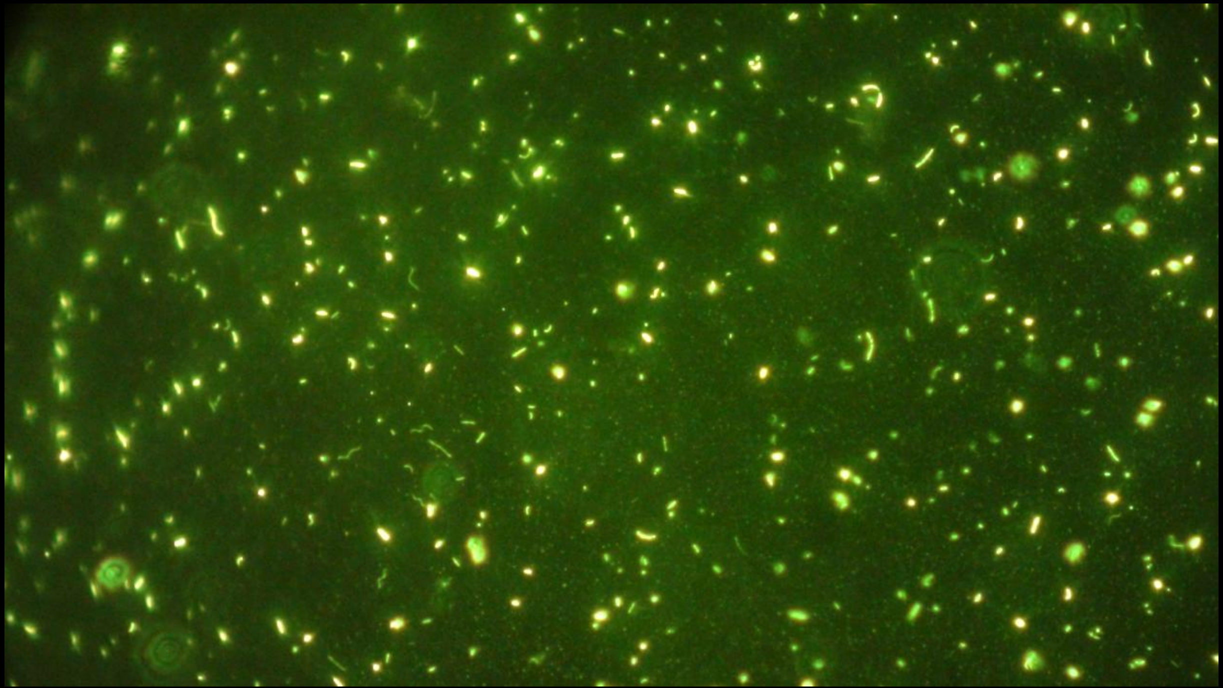
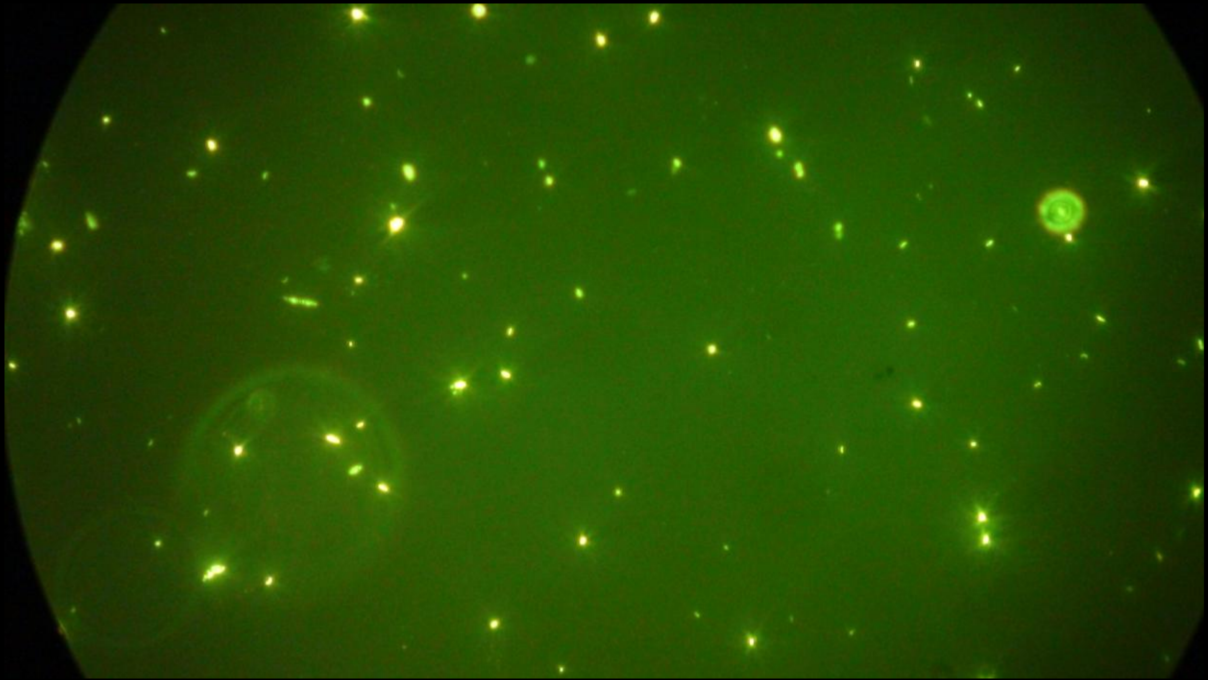
Dust particles can suppress precipitation = feedback loops

Dust may cause regional cooling through adsorption of UV and reflection

There is speculation that dust has kept the oceans from warming as fast as was expected = a natural counter to global warming events

Dust may also serve as a nutrient source for marine phototrophs = reduction In CO_2

And select microbial heterotrophs!!!

African Dust Storms May Cool Atlantic, Lessen Hurricanes

ScienceDaily (Feb. 20, 2008) — Every year, storms over West Africa disturb millions of tons of dust and strong winds carry those particles into the skies over the Atlantic. According to a recent study led by University of Wisconsin-Madison atmospheric scientists, this dust from Africa directly affects ocean temperature, a key ingredient in Atlantic hurricane development.

See also:

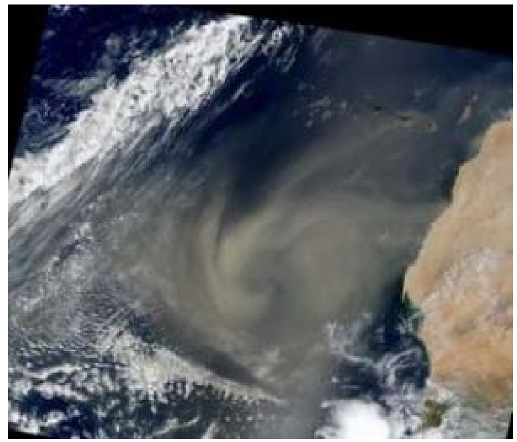
Earth & Climate
- Severe Weather
- Storms
- Hurricanes and Cyclones
- Geography
- Weather
- Air Pollution

Reference
- Dust storm
- List of major natural disasters in the United States
- National Hurricane Center
- Great Hurricane of 1780

"At least one third of the recent increase in Atlantic Ocean temperatures is due to a decrease in dust storms," says lead author Amato Evan, a researcher at UW-Madison's Cooperative Institute for Meteorological Satellite Studies (CIMSS).

In a paper published online in "Geochemistry, Geophysics, Geosystems," the team of scientists describes how dust in the atmosphere cools the ocean by decreasing the amount of energy that reaches the water. The study also demonstrated that the large amount of dust blowing off of Africa in the 1980s and '90s likely cooled the Atlantic enough to prevent conditions that could have resulted in more devastating hurricane seasons similar to 2004 and 2005.

As dust from Africa accumulates in the skies over the Atlantic, the atmosphere above the ocean begins to resemble the conditions over Africa. Millions of tons of dust create a drier environment and also reduce the amount of sunlight that reaches the ocean. Using a 25-year data record created by co-author Andrew Heidinger, a researcher with the National Oceanic and Atmospheric Administration (NOAA), Evan assessed how much the dust cooled the temperature of the



An image, captured on Sept. 4, 2005, by the Moderate Resolution Imaging Spectroradiometer aboard NASA's TERRA satellite, shows a massive dust storm (in yellow) blowing off the western coast of Africa over the Atlantic Ocean. Amato Evan, a researcher at the UW-Madison Cooperative Institute for Meteorological Satellite Studies, has found a surprising link between hurricane frequency in the Atlantic Ocean and dust storms that periodically rise up from the Sahara desert and move west. Evan and others suggest that such atmospheric dust could be helping to "dampen" brewing hurricanes. (Credit: NASA/courtesy Amato Evan)

Just In:
Microbes Trigger Ice Formation In Clouds

Science Video News

Dust Storms And Hurricanes
Meteorologists have found a new discovery may boost the accuracy of the forecasts. The surprising factor is dust, researchers have found that years. ... > *full story*

- Atmospheric Physicists Develop Dust Storm Forecasting System
- Meteorologists, Atmospheric Scientists Perfect Next-Generation Weather Simulation
- Cool Pacific Waters May Not Affect Upcoming Hurricane Season
- *more science videos*

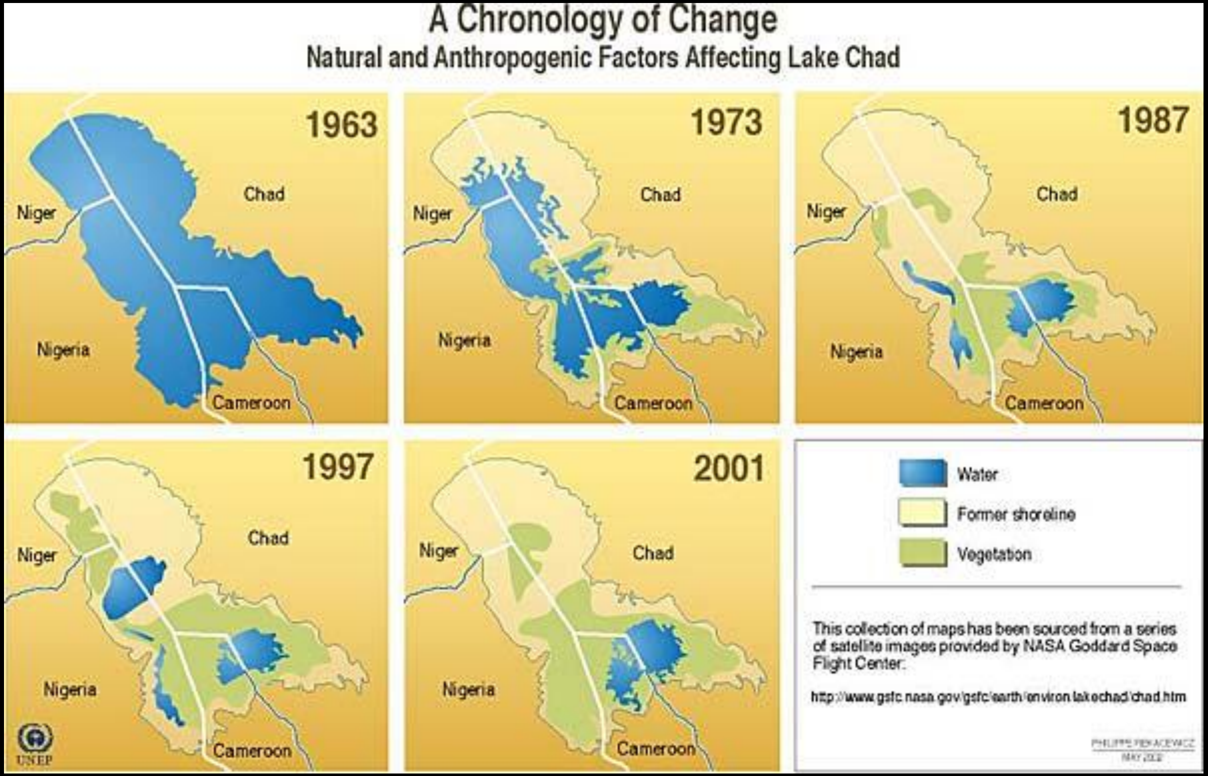
Breaking News
... from NewsDaily.com

- Antarctic team boosts medical care with 3D ultrasound

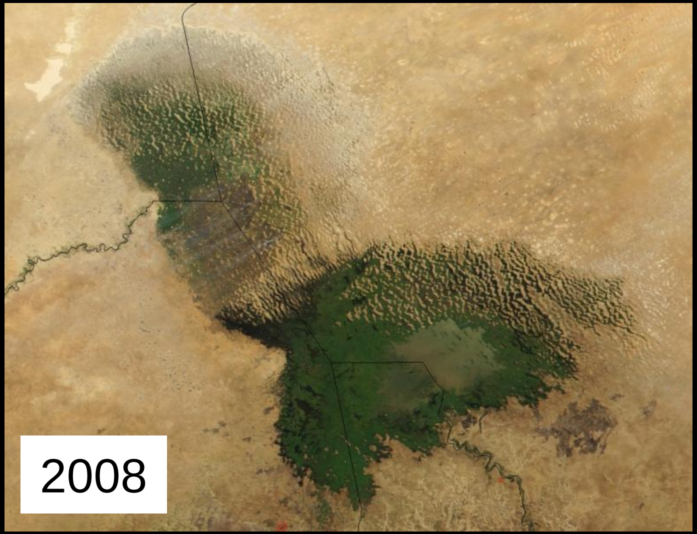
REUTERS

DUST AND THE HUMAN INFLUENCE?

The overall size of the Sahara has not changed in recent history

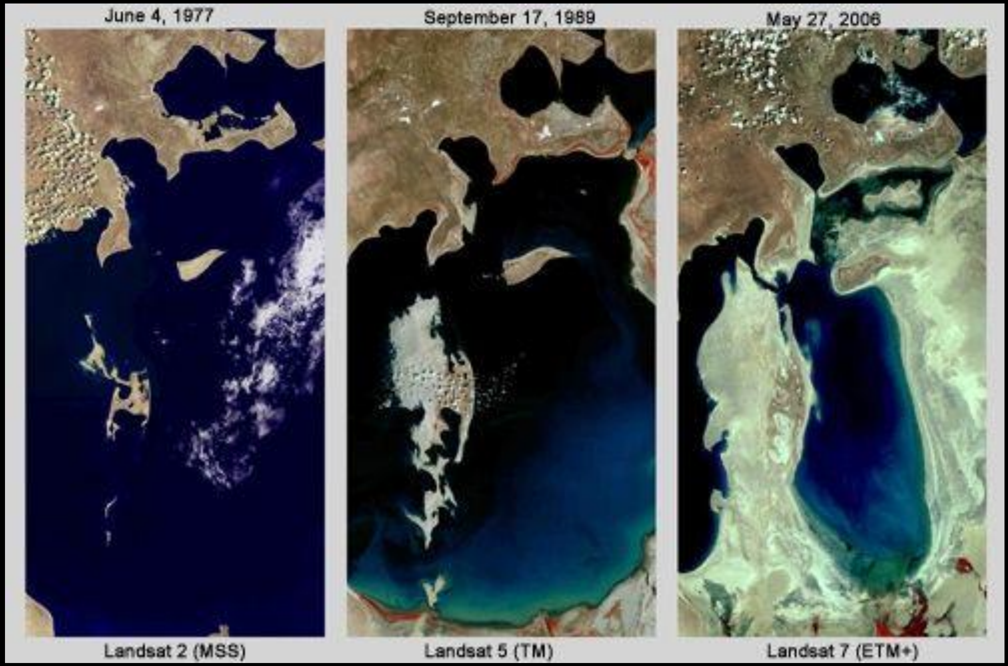


A Chronology of Change
Natural and Anthropogenic Factors Affecting Lake Chad
1963
1973
1987
1997
2001
Chad
Niger
Nigeria
Cameroon
Water
Former shoreline
Vegetation
This collection of maps has been sourced from a series of satellite images provided by NASA Goddard Space Flight Center.
http://www.gsfc.nasa.gov/gsfc/earth/environ/lakechad/chad.htm
UNEP



2008

The Aral Sea


June 4, 1977
September 17, 1989
May 27, 2006
Landsat 2 (MSS)
Landsat 5 (TM)
Landsat 7 (ETM+)


2000
2009

Iraq drought continues, as sandstorms worsen

Dams in Turkey, Syria also blamed for low water levels, devastated farms

Associated Press

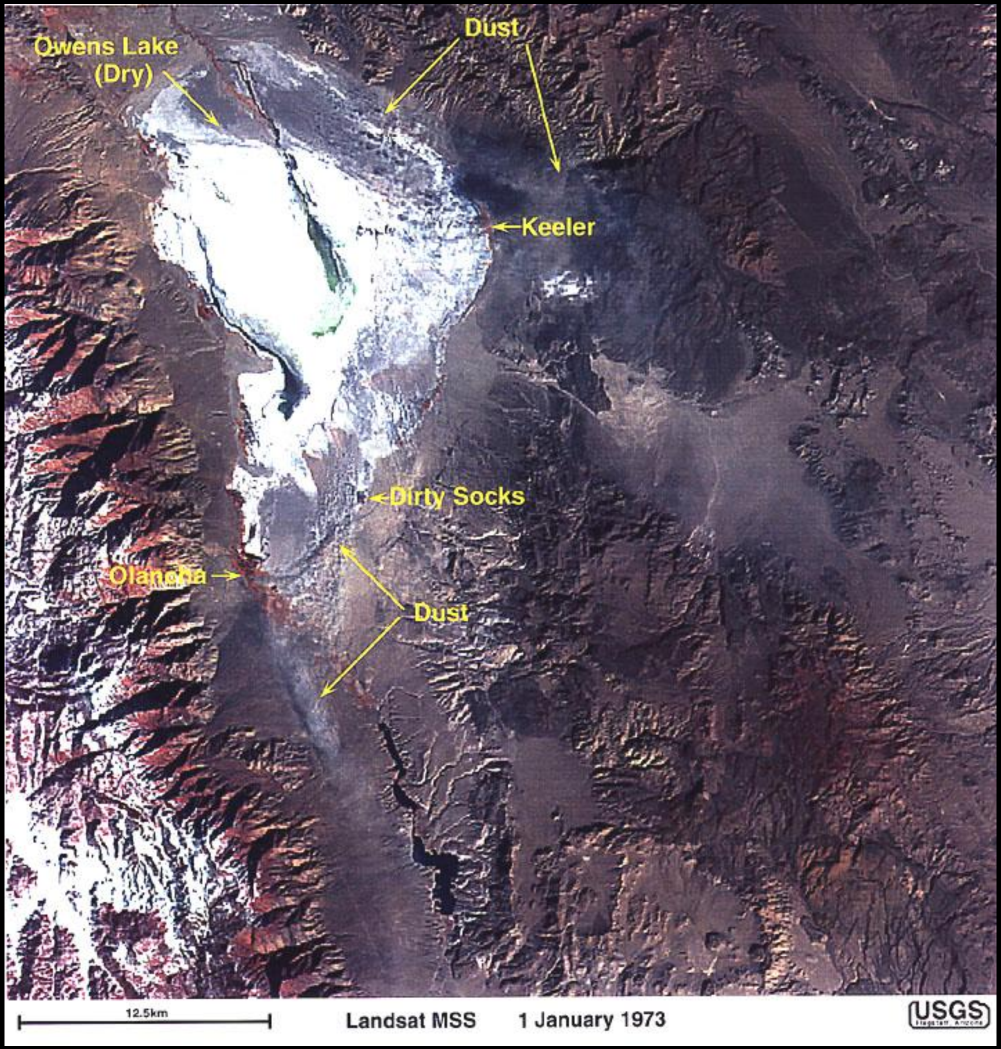
updated 2 hours, 45 minutes ago

BAGHDAD - Below-average rainfall and insufficient water in the Euphrates and Tigris rivers have left Iraq bone dry for a second straight year, wrecking swaths of farm land, threatening drinking water supplies and intensifying fierce sandstorms that have coated the country in brown dust.

Sandstorms hit more often

A decline in acreage where plant roots once knitted the soil has only increased the severity of sandstorms, which are blowing across Iraq with increased frequency — nearly 20 so far this year. Two people died in the eastern city of Kut, and hundreds of Iraqis complaining of respiratory problems crowded emergency rooms across Iraq during the most recent three-day sandstorm, which many said was the worst in memory.

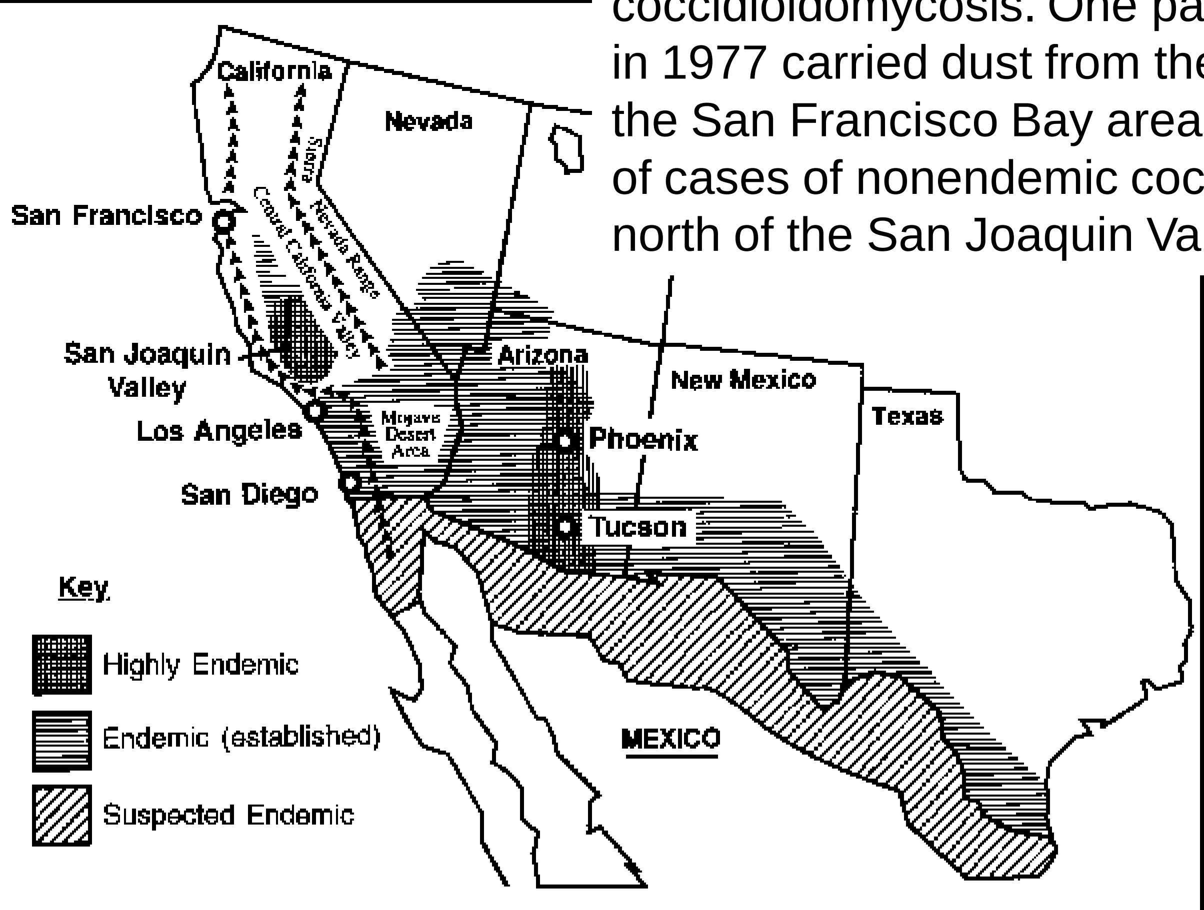
Water was first diverted from the Owens River to the City of Los Angeles in 1913, and by 1926 Owens Lake was dry.



‘When we see the white cloud headed down through the pass, the ER and doctors' offices fill up with people who suddenly got worse. It's a pretty straightforward cause and effect,’ said Dr. Bruce Parker, an emergency physician at Ridgecrest Community Hospital." An additional health concern is inhalation of trace metals in the dust. The lake bed has a mean arsenic concentration of 50 ppm

Coccidioidomycosis and Dust

“Dust storms are frequently followed by outbreaks of coccidioidomycosis. One particularly severe dust storm in 1977 carried dust from the San Joaquin Valley up to the San Francisco Bay area and resulted in hundreds of cases of nonendemic coccidioidomycosis in areas north of the San Joaquin Valley”



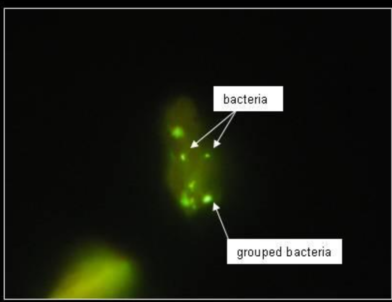
Quote and Figure from Kirkland and Fierer, 1996. EID, 2(3)

Soil Microbiology

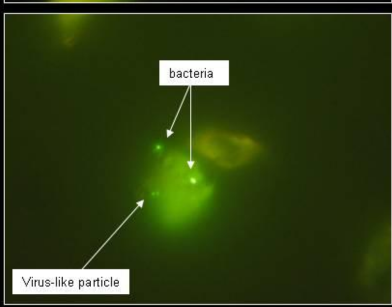
- Bacteria populations in soils typically range from 10^6 to 10^9 cells/gram as determined via direct count assay
- The current estimate of culturable bacteria and any sample type is 0.1 to 10% of the total population
- The typical number of bacterial species per gram of soil ~ 10,000
- The dominant genera typically found is *Bacillus*
- Fungal populations typically ~ 10^6/gram
- Virus populations ~ 10^5 to 10^6/gram
- Protozoan ~ 10^4/gram

SE 10-Jul-00 WD10.7mm 15.0kV x15k 2um

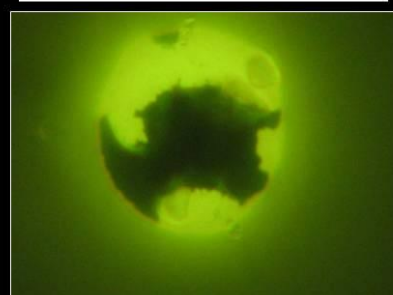
Kuwait dust, sample #5 – size fraction 10 to 15um



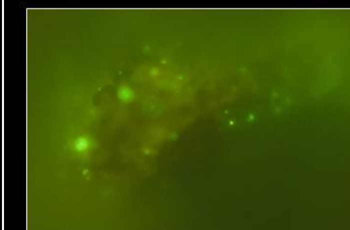
Left 2 photos – dust particles coated with bacteria. The green fluorescing dots on the particles are single or grouped bacteria. Very fine fluorescing dots are virus-like particles. Individual bacteria are ~1um in size.



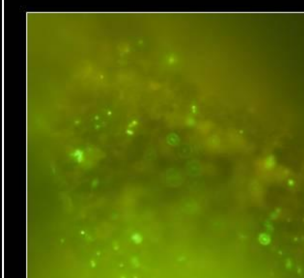
Bottom photo – peculiar unknown particle which appears to contain a dark irregular core encased in porous clear scales

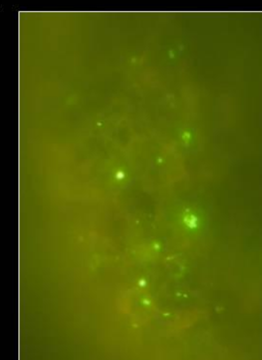


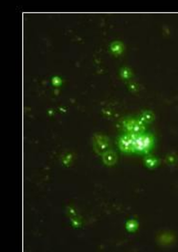
Kuwait dust, sample #2 raw/bulk North



1000x magnification. These images show large particles coated with bacteria and virus like particles. Each fluorescing particle Is a bacterium (~1um in size), group of bacteria or a virus-like particle










Mali Bacterial Pathogens Detected

10% are animal pathogens

5% are plant pathogens

27% are opportunistic human pathogens

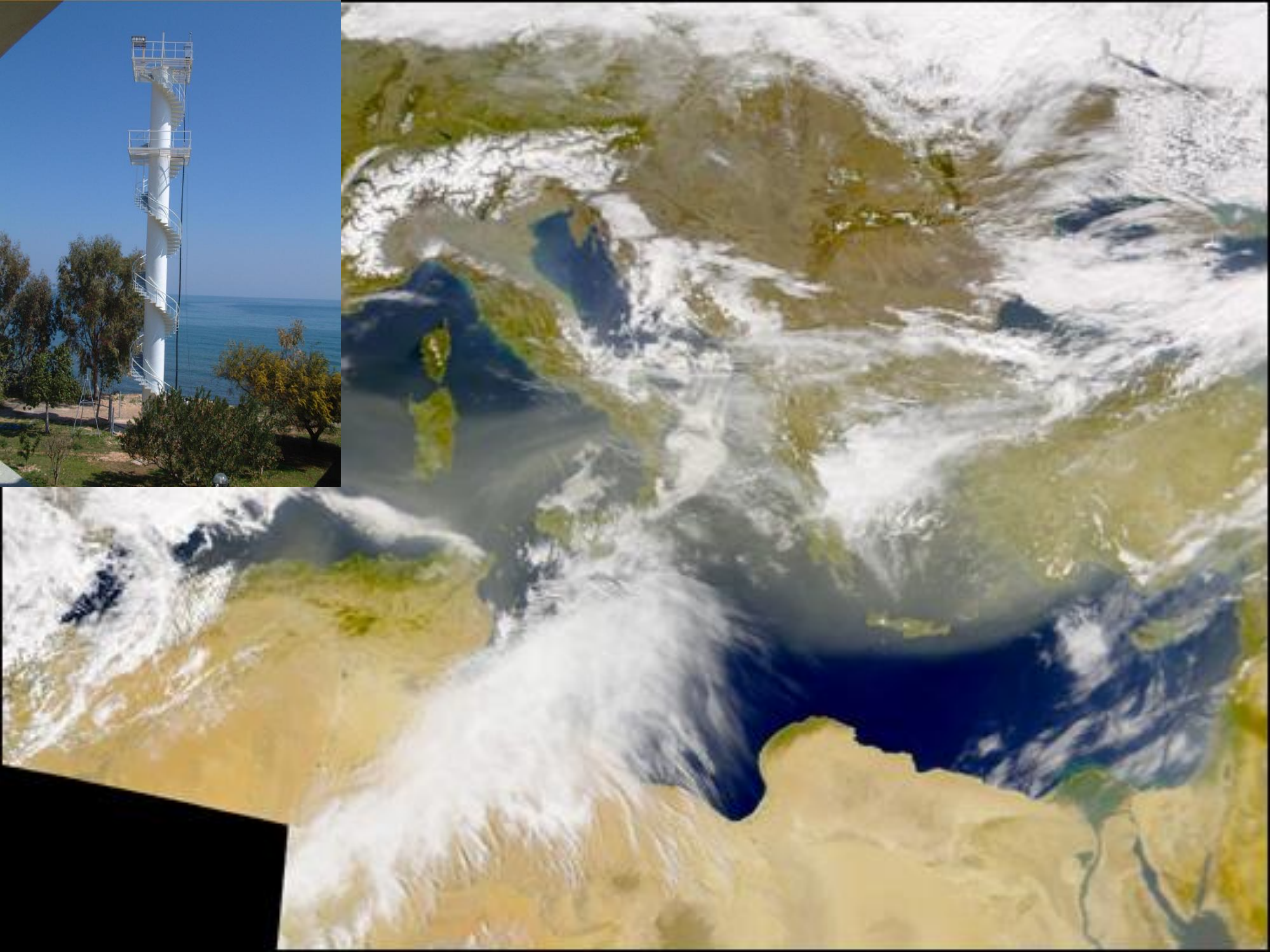
Examples:

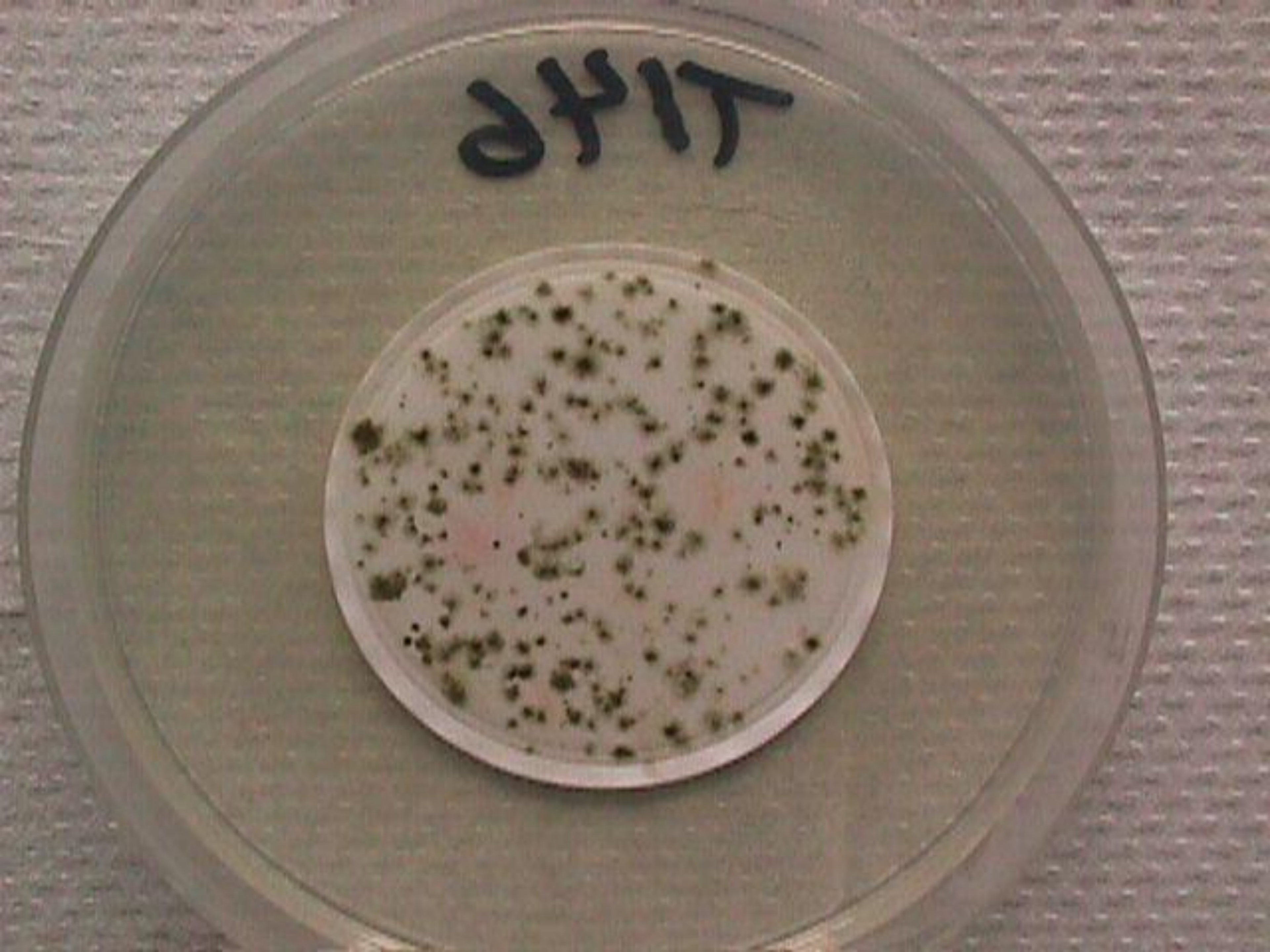
Staphylococcus xylosis--cause of septicemia in loggerhead turtles in the Canary Islands

Bacillus pumilus--cause of ‘bacterial blotch’ on peaches

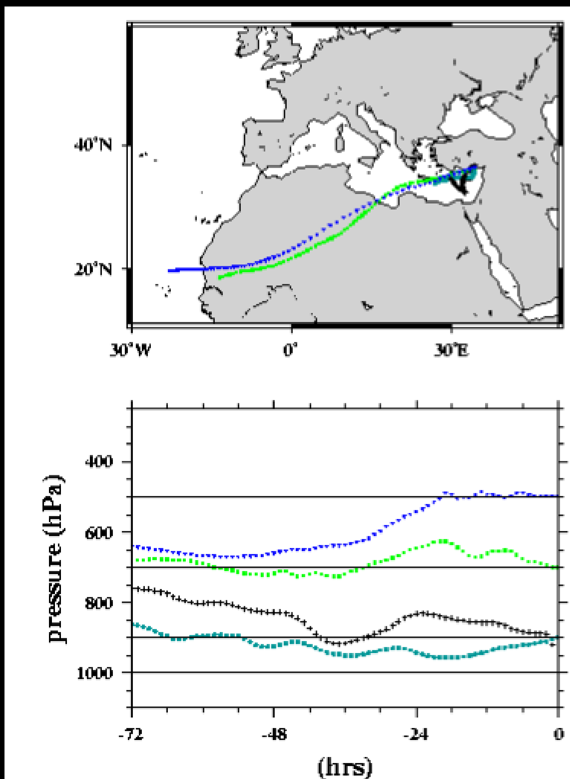
Gordonia terrae--cause of infection in immunocompromised patients

USGS

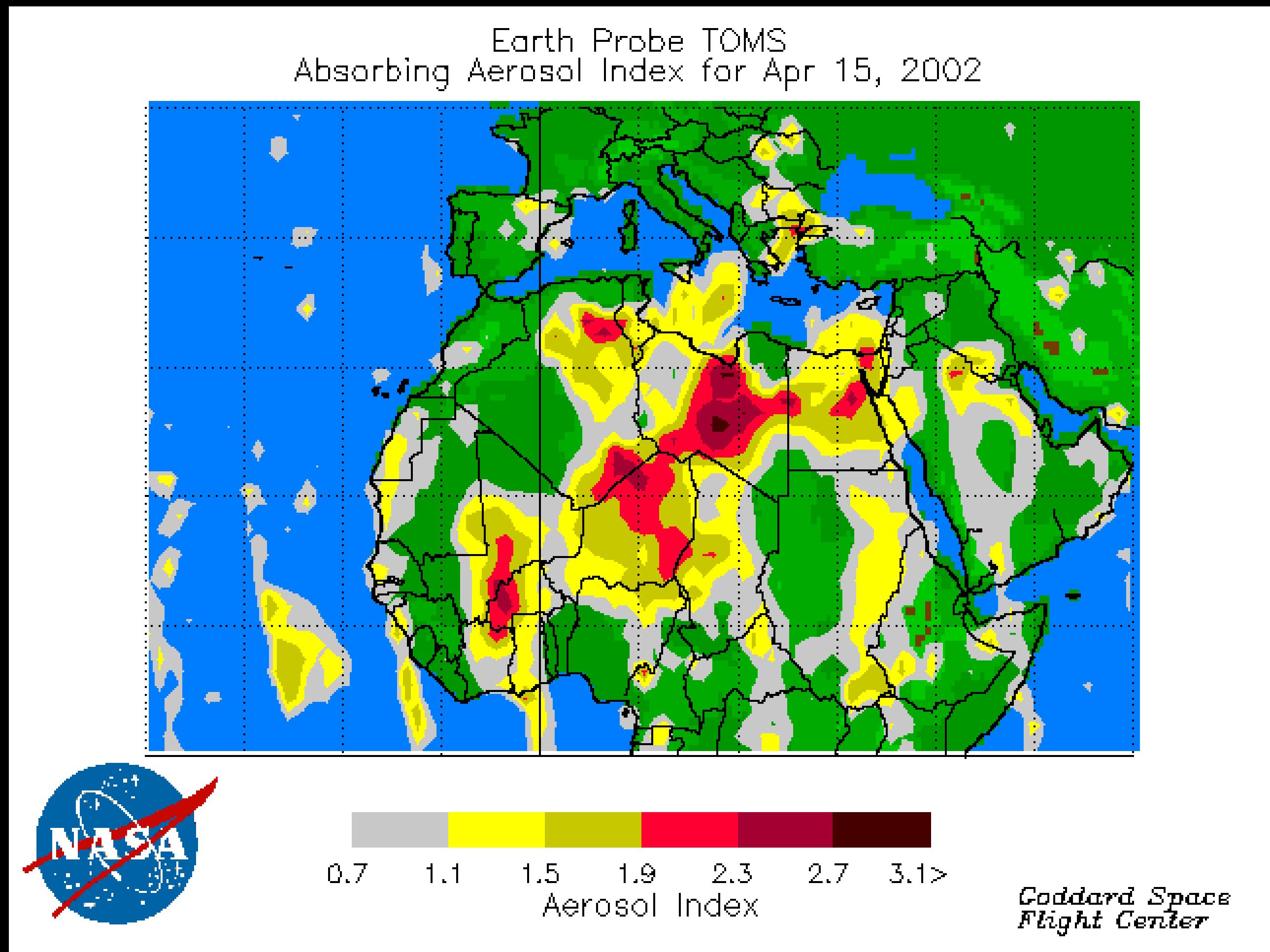




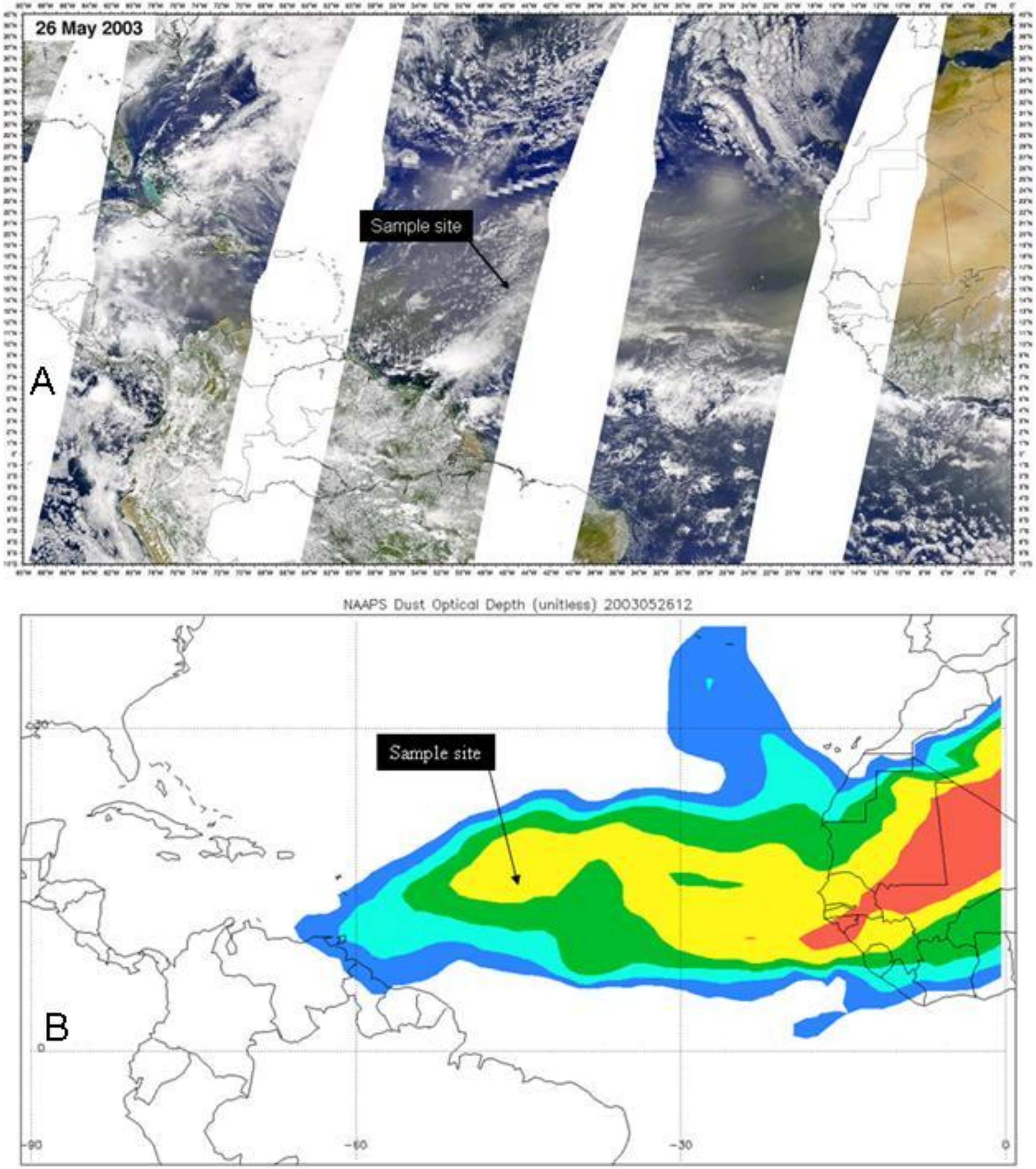
24	4/14/02	9:00/20	0	4
25	4/14/02	14:54/20	0	2
Blank5	4/14/02	15:16/20	0	0
26	4/15/02	8:27/20	5	38
27	4/15/02	13:42/20	3	35
28	4/15/02	17:33/20	6	121
29	4/16/02a	15:03/40 (filte	1	33
29	4/16/02b	15:03/40 (filte	0	34
Blank6	4/16/02	15:47/20	0	0



Model – European Center for Medium-Range Weather Forecasts. http://www.ecmwf.int/

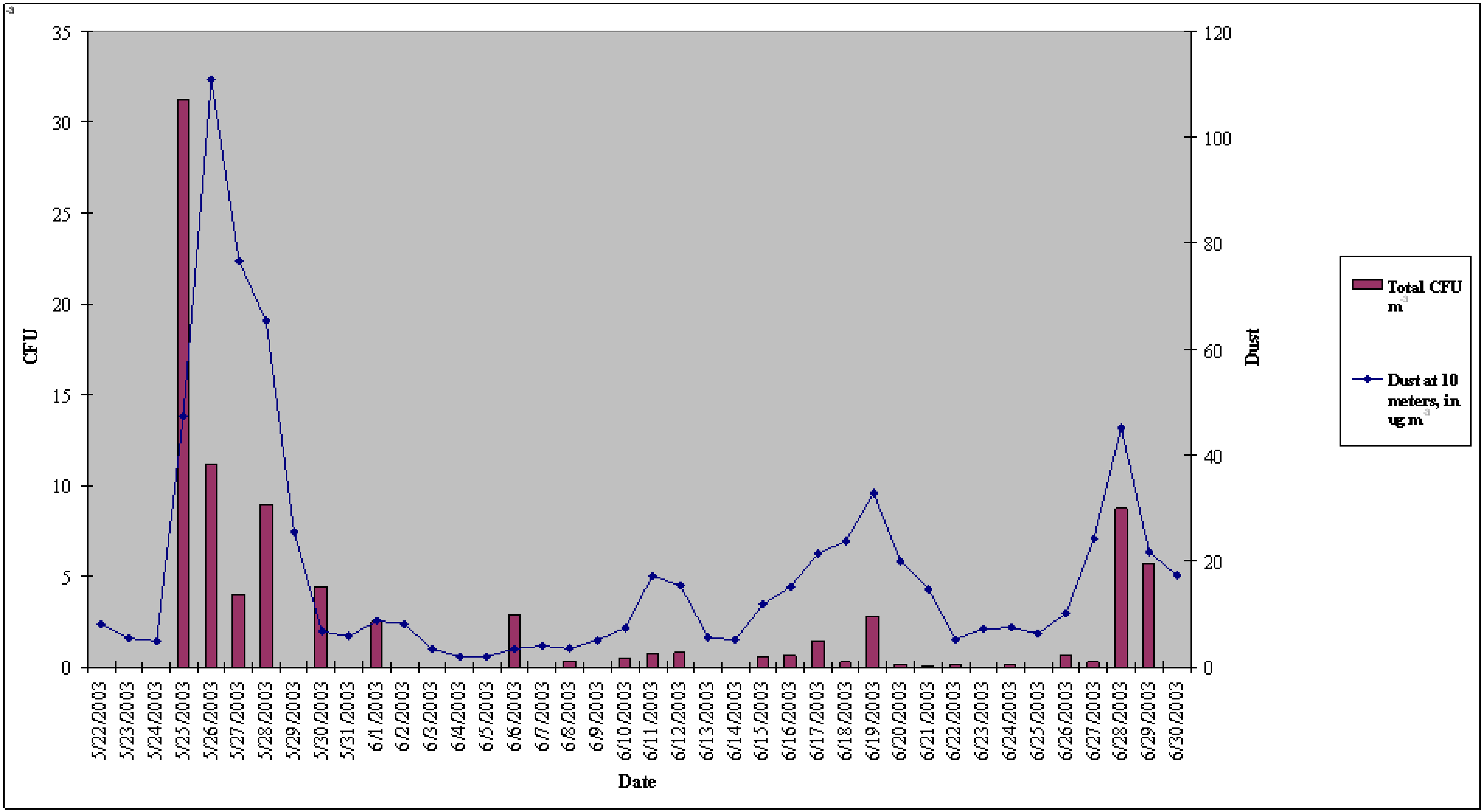


ODP Leg 209
May – June 2003



ODP Leg 209 – a statistically significant correlation between airborne microorganisms and the NAAPS model dust deposition values.

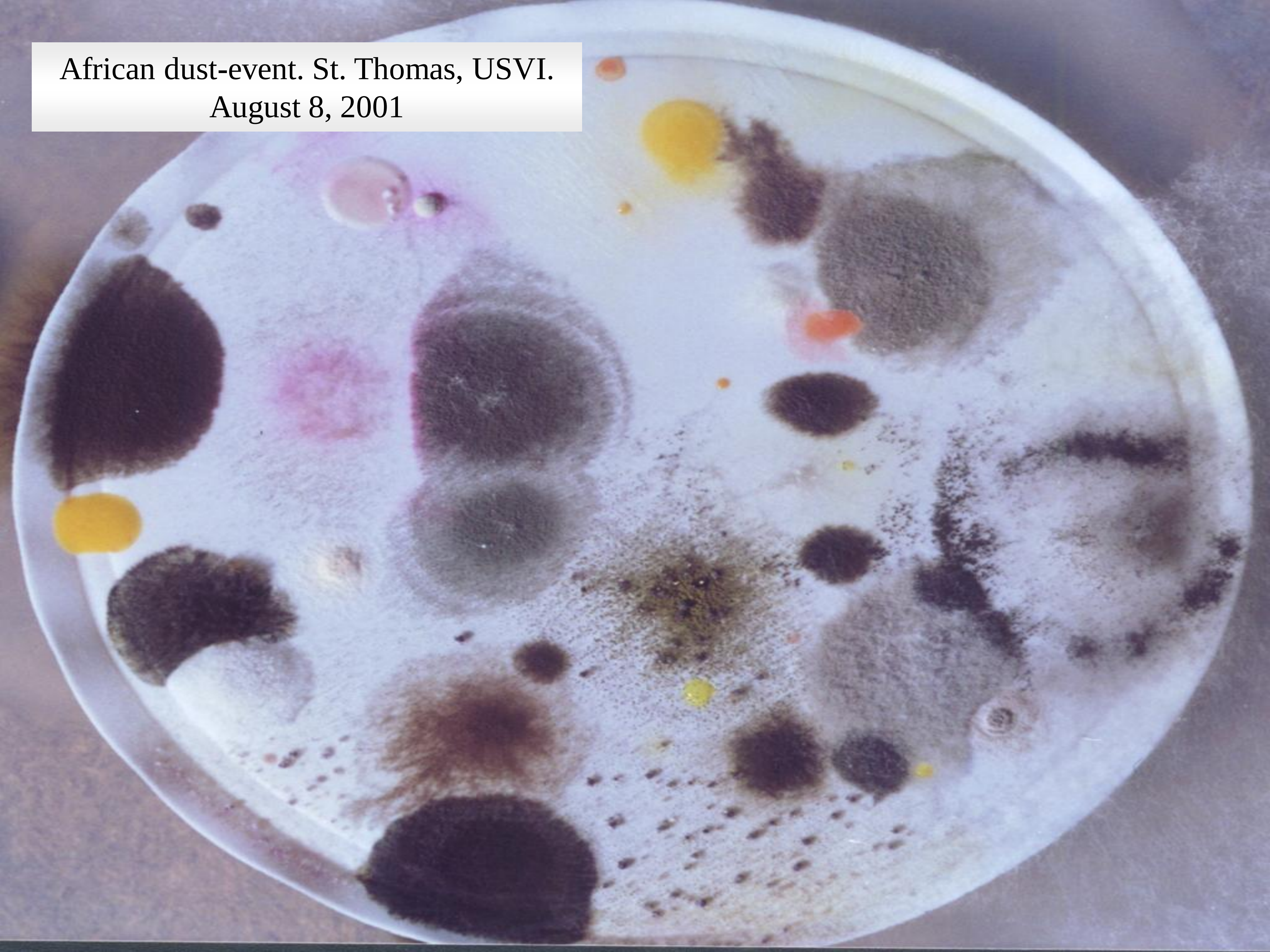
Tropical mid-Atlantic ridge, May – June 03

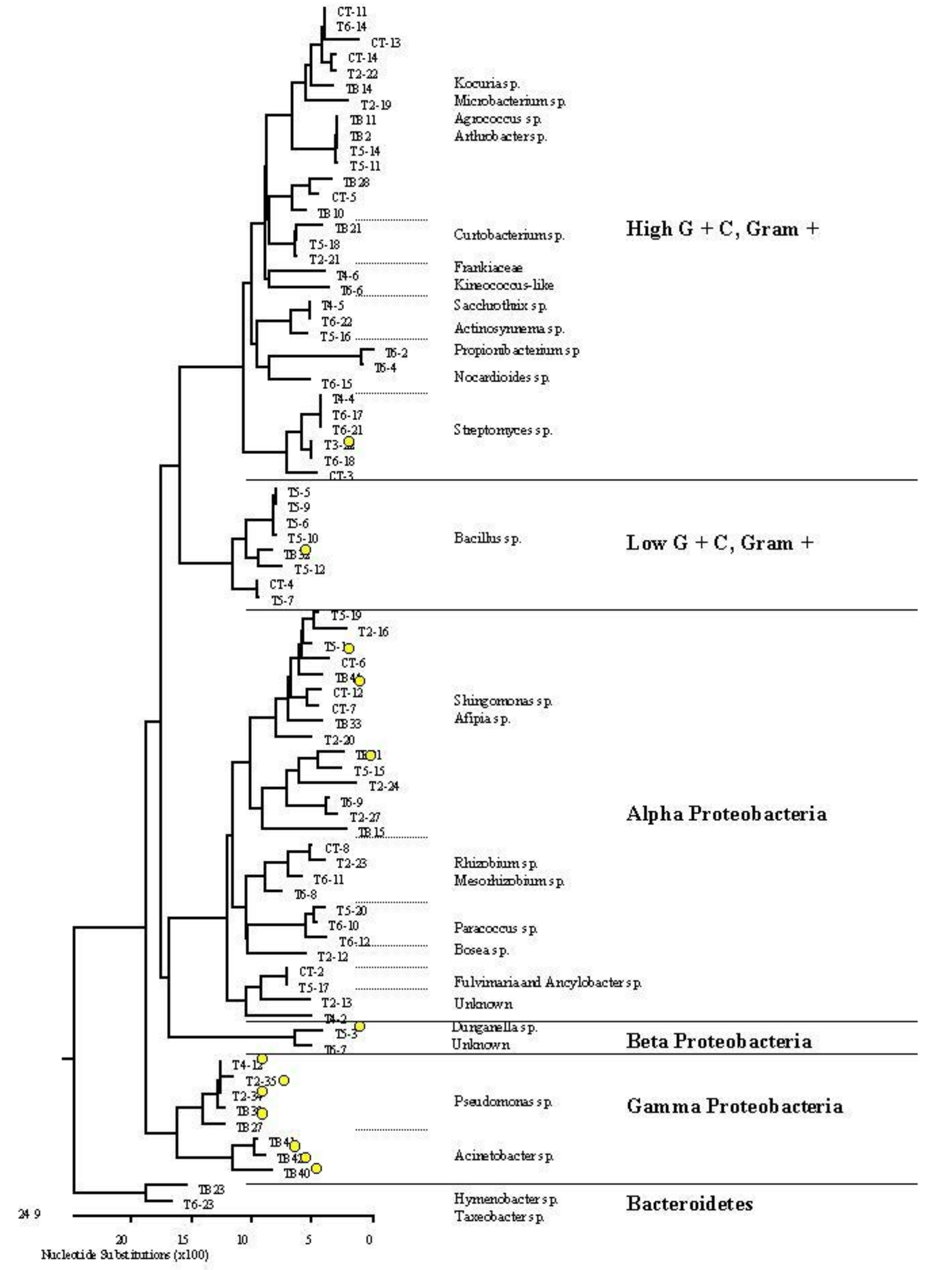


Tropical Mid-Atlantic Ridge Aerobiology (May-June 2003)

- 28 bacteria and 72 fungi isolated
- Bacteria - 2/4 *Bacillus aminovorans* and *Kocuria rosea* (human catheter related bacteremia) 100% DNA homology to two Mali isolates. The remaining 2 *B.aminovorans* and a *Bacillus* sp. isolate also closely identified to Mali isolates.
- Bacteria - *3 Gordonia terra* isolates = human pathogen (sepsis, brain abscess) and this species also isolated in Mali
- Fungi - *Massaria platani* (Florida sycamore canker pathogen) and *Alternaria dauci* (Florida carrot pathogen) also isolated
- Most dominant fungal isolate *Lojkania enalia* (10 CFU) – the only commercially available strains were isolated in Liberia, Africa
- 25% of fungi isolated are known pathogens of some organism (i.e., plant or animal, 4 CFU of *Neotestudina rosatii* – human pathogen - mycetoma)


African dust-event. St. Thomas, USVI.
August 8, 2001





~ 10% of Caribbean African dust isolates are known human opportunistic pathogens

~20% of Caribbean African dust isolates are known plant or animal pathogens

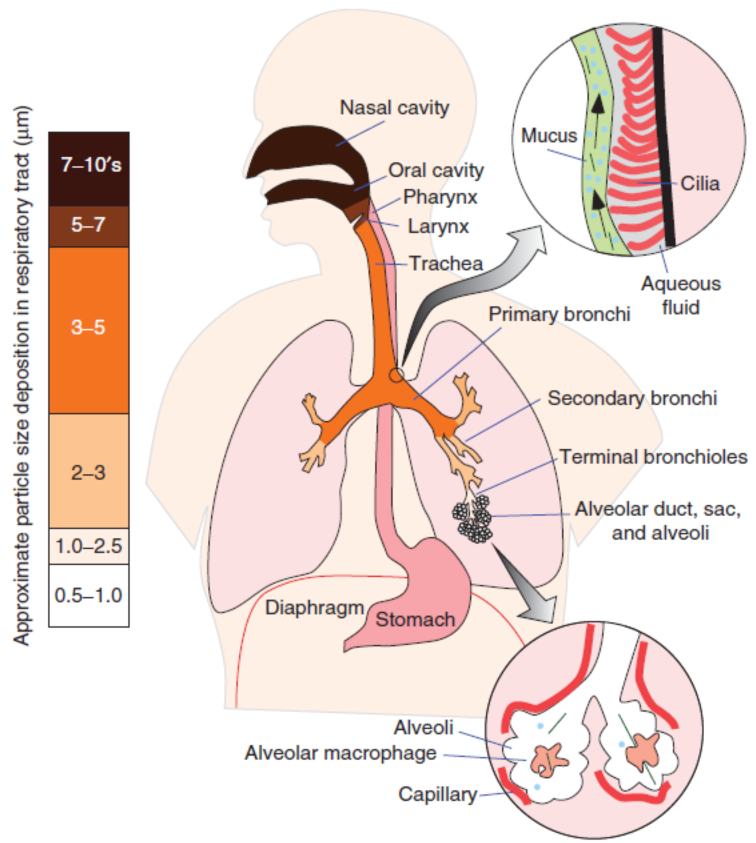


Figure 3 A schematic diagram of the respiratory system shows the fractionation of particle sizes that occurs with progressive depth in the system. After Newman (2001).

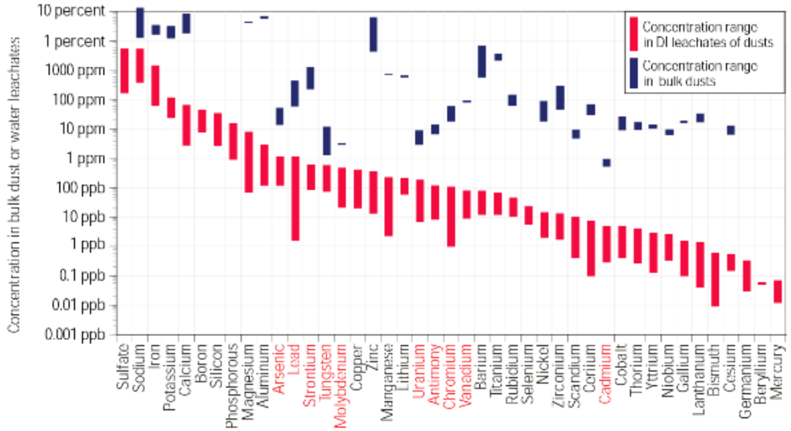
The Medical Geochemistry of Dusts, Soils, and Other Earth Materials
G.S. Plumlee and T.L. Ziegler
US Geological Survey, Denver, CO, USA

Health effects of dust from Owens (dry) Lake

with Geoff Plumlee

Many heavy metals readily released from dust into leachate water, especially elements that form alkaline-mobile oxyanion or carbonate species in solution (W, Mo, As, Pb, U, Sb, Cr, V)

Most readily soluble heavy metals are in soluble alkaline, carbonate, sulfate salts



Dust Associated Anthropogenic

- Pesticides (phosalone) - in airborne dust near the Aral Sea - at concentrations as high as 126mg/kg. . ***O'hara et al. 2000. Lancet*.**

- DDT residue found in children's blood and human breast milk in the vicinity of the Aral Sea. ***Jensen et al. 1997. Sci. Tot. Env.*** and ***Hooper et al. 1997. EHP.***

- Certain pesticides and herbicides were only found in Israel's atmosphere during African dust events (degradation products of trifluraline or profluraline and degradation products of pyridyltetrazole-containing herbicides). ***Falkovich et al. 2004. J. Geophys. Res.***

- Radioisotopes – elevated levels of Cesium – 137 (Chernobyl origin) occurred in a Saharan dust/rain event in Greece. ***Papastefanou et al. 2000. J. Env. Radioactivity.***

- Metals, industrial waste, hydrocarbons?

- Antibiotics to soil through wastewater disposal = potential for resistant pathogens that may be spread through the atmosphere (crop, livestock, human, etc.)

Conclusions

- How will future climate change influence dust transport?

  As history illustrates through ice core deposits – colder phases = increased transport due to a higher percentage of water existing as ice (more exposed sediments, less precipitation).

- Lake Owens, Lake Chad, and the Aral Sea are prime examples of human activity influencing dust transport.
- Legislation such as the US Soil Conservation and Domestic Allotment Act of 1935 limited harmful agricultural practices utilized during the American Dust Bowl, but climate change (the end of the drought) is believed to be responsible for the end of that regional event.
- Desert dust may suppress global warming through light reflection and adsorption in addition to serving as a nutrient source for marine phototrophs (increase in carbon fixation.
- Exposure to desert dust does pose a risk to human health and climate change will influence degrees of risk.
- Desert dust transport and its influence on human, economic, and ecosystem health is a poorly understood emerging field of research that has obvious global scale implications.

“Children coughed and gagged, dying of something the doctors called ‘dust pneumonia.’ In desperation, some families gave away their children. The instinctive act of hugging a loved one or shaking someone’s hand could knock two people down, for the static electricity from the dusters was so strong. Ike Osteen’s life spans the flu epidemic of 1918, the worst depression in American history, and a world war that ripped apart the globe. Nothing compares to the black dusters of the 1930s, he says, a time when the simplest thing in life – taking a breath – was a threat”

Egan, T., p. 5-6, (2006) The Worst Hard Time